

**PM<sub>2.5</sub>, NO<sub>x</sub> AND CO  
EMISSIONS FROM THE  
VICTOR SCHOOL  
MESSERSMITH HURST  
STEAM BOILER  
VICTOR, MONTANA**

**Test Dates: February 12-13, 2008**

*Prepared for:*

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*Report Date:*

**April 4, 2008**

## EXECUTIVE SUMMARY

Bison Engineering, Inc. (Bison) was retained by Bitter Root RC&D to perform emissions testing for particulate matter less than 2.5 microns (PM<sub>2.5</sub>), total particulate matter (TPM), nitrogen oxides (NO<sub>x</sub>) and carbon monoxide (CO) on the Victor School Messersmith Hurst steam-fired hot water boiler located in Victor, Montana. The following table presents the results of the low-fire and high-fire testing.

**Table 1: Messersmith Hurst Steam Boiler Stack Emissions**

<b>Messersmith Hurst Steam Hot Water Boiler Victor School, Victor, MT Stack Emissions</b>			
<b>Emissions</b>	<b>Units</b>	<b>Low-Fire Feb. 12, 2008</b>	<b>High-Fire Feb. 13, 2008</b>
<b>PM<sub>2.5</sub></b>	Concentration	0.0230 gr/dscf	0.0379 gr/dscf
	Mass rate	0.099 lbs/hr	0.247 lbs/hr
	Emission factor	0.097 lbs/MMBtu	0.099 lbs/MMBtu
<b>TPM</b>	Concentration	0.033 gr/dscf	0.073 gr/dscf
	Mass rate	0.142 lbs/hr	0.473 lbs/hr
	Emission factor	0.139 lbs/MMBtu	0.192 lbs/MMBtu
<b>NO<sub>x</sub></b>	Concentration	43.2 ppm <sub>dv</sub>	58.8 ppm <sub>dv</sub>
	Mass rate	0.16 lbs/hr	0.32 lbs/hr
	Emission factor	0.153 lbs/MMBtu	0.129 lbs/MMBtu
<b>CO</b>	Concentration	205 ppm <sub>dv</sub>	155 ppm <sub>dv</sub>
	Mass rate	0.45 lbs/hr	0.51 lbs/hr
	Emission factor	0.44 lbs/MMBtu	0.20 lbs/MMBtu
<b>Heat Input</b>		1.02 MMBtu/hr	2.48 MMBtu/hr
<b>Percent of 2,600,000 Btu/hr</b>		39%	96%

### **Table Nomenclature**

gr/dscf	grains per dry standard cubic feet (@ 68°F and 1 atm.)
lbs/hr	pounds per hour
lbs/MMBtu	pounds per million British thermal units
ppm <sub>dv</sub>	parts per million dry volume
MMBtu/hr	million British thermal units per hour
%	percent

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## 1.0 INTRODUCTION

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Bison Engineering, Inc. (Bison) was retained by Bitter Root RC&D to perform air quality emissions testing on the Victor School Messersmith Hurst steam-fired hot water boiler located in Victor, Montana. The testing was performed according to the details listed in this report. The low-fire test was performed on February 12 followed by the high-fire test on February 13, 2008.

This report summarizes the results from the testing project and the operating conditions of the process during the testing. The appendices of this report contain the pretest protocol, spreadsheets, testing field data, production data, nomenclature and formulae, equipment/analyzer calibrations and audits, and Protocol 1 gas certifications.

### 1.1 Program Organization

Bison is a full service air quality consulting company that provides ambient air and meteorological monitoring, air quality permitting, air quality modeling, regulatory negotiations, process-to-emissions optimization and source testing services. Bison's **Process and Emission Services** team is led by Calvin Loomis, P.E., Project Engineer and Team Leader. Additional team members are Mike Chovanak, E.I.T., Project Engineer; Bill Shaw, P.E., Project Engineer; Dave Blankenship, Senior Environmental Technician; and Jim Wollenberg, Environmental Technician.

**Primary:**

Bitter Root RC&D  
Address: 1709 N. First Street  
Hamilton, Montana 59840  
Contact: Tom Coston  
Phone: 406/363-1444 ext. 5

**Facility Info:**

Victor High School  
Contact: Lyle Thompson, Maintenance Supervisor  
Phone: 406/642-3221  
Email : [lyle@victor.k12.mt.us](mailto:lyle@victor.k12.mt.us)

**Boiler Contact:**

Messersmith Manufacturing, Inc.  
Contact: Gary Messersmith  
Phone: 906/466-9010  
Email: [messersmith@burnchips.com](mailto:messersmith@burnchips.com)

**Consultant:**

Bison Engineering, Inc.  
Address: 1400 11<sup>th</sup> Avenue  
Helena, MT 59601  
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Mike Chovanak, ext. 276  
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Email: [bison@bison-eng.com](mailto:bison@bison-eng.com)

## **2.0 EMISSION SOURCE INFORMATION**

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### **2.1 Facility Description**

Victor School is an educational facility located in Victor, Montana.

### **2.2 Emission Source Description**

The Victor School operates a 2,600,000 Btu/hr Hurst steam-fired hot water boiler manufactured by Messersmith. The boiler has a stack with a 13-inch inside diameter.

### 3.0 TEST RESULTS SUMMARY

#### 3.1 Summary of Emissions Determination

The following tables present the results from the February 12-13, 2008, emissions testing on the Messersmith Hurst steam-fired hot water boiler stack. The emission data is presented in grains per dry standard cubic feet (gr/dscf), pounds per hour (lbs/hr), pounds per million British thermal units (lbs/MMBtu) and parts per million dry volume (ppmdv). Additional emission data and nomenclature can be found in the appendices of this report.

**Table 2a: Messersmith Hurst Boiler Low-Fire Test Results**

<b>Victor School, Victor, MT Messersmith Hurst Steam-Fired Boiler Low-Fire Emissions, February 12, 2008</b>				
		<b>Run 1</b>	<b>Run 2</b>	<b>Avg.</b>
Stack Flow	acfm	889	896	893
	dscfm	507	503	505
PM <sub>2.5</sub>	gr/dscf	0.0172	0.0287	0.0230
	lbs/hr	0.075	0.124	0.099
	lbs/MMBtu	0.075	0.119	0.097
TPM	gr/dscf	0.0268	0.0390	0.0329
	lbs/hr	0.117	0.168	0.142
	lbs/MMBtu	0.118	0.161	0.139
<b>Combustion Gases</b>				
NOx	ppmdv	41.4	44.9	43.2
	lbs/hr	0.150	0.161	0.155
	lbs/MMBtu	0.151	0.154	0.153
CO	ppmdv	219.5	191.0	205.3
	lbs/hr	0.485	0.419	0.452
	lbs/MMBtu	0.490	0.401	0.445
<b>Operating Conditions</b>				
Oxygen, % dry		14.5	14.7	14
Heat Input, MMBtu/hr		0.99	1.04	1.02
Percent of 2,600,000 But/hr		38%	40%	39%

**Table 2b: Messersmith Hurst Boiler Low-Fire PM Proportions**

<b>Victor School, Victor, MT Messersmith Hurst Steam-Fired Boiler Low-Fire PM Emissions Proportions February 12, 2008</b>	
PM greater than 2.5	30%
Filterable PM <sub>2.5</sub>	61%
Condensable PM	9%

**Table 3a: Messersmith Hurst Boiler High-Fire Test Results**

<b>Victor School, Victor, MT                      Messersmith Hurst Steam-Fired Boiler                      High-Fire Emissions, February 13, 2008</b>				
		Run 1	Run 2	Avg.
Stack Flow	acfm	1455	1366	1411
	dscfm	776	746	761
PM <sub>2.5</sub>	gr/dscf	0.0361	0.0397	0.0379
	lbs/hr	0.240	0.253	0.247
	lbs/MMBtu	0.105	0.094	0.099
TPM	gr/dscf	0.0725	0.0727	0.0726
	lbs/hr	0.482	0.465	0.473
	lbs/MMBtu	0.212	0.173	0.192
<b>Combustion Gases</b>				
NOx	ppmdv	56.4	61.1	58.8
	lbs/hr	0.313	0.325	0.319
	lbs/MMBtu	0.137	0.121	0.129
CO	ppmdv	100.6	210.0	155.3
	lbs/hr	0.340	0.683	0.512
	lbs/MMBtu	0.150	0.254	0.202
<b>Operating Conditions</b>				
Oxygen, % dry		11.3	9.1	10
Heat Input, MMBtu/hr		2.28	2.69	2.48
Percent of 2,600,000 But/hr		87.7%	103%	96%

**Table 3b: Victor School, Messersmith Hurst Boiler High-Fire PM Proportions**

<b>Victor School, Victor, MT                      Messersmith Hurst Steam-Fired Boiler                      High-Fire PM Emissions Proportions                      February 13, 2008</b>	
PM greater than 2.5	48%
Filterable PM <sub>2.5</sub>	49%
Condensable PM	3%

### 3.2 Production Data

Boiler production data is presented in the test results tables.

### 3.3 Field Notes

Testing proceeded without interruption. There were no deviations from the methods listed in this report.

## 4.0 TESTING PROCEDURES

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### 4.1 Sampling Site Locations

Sample site locations were determined by Method 1.

### 4.2 Test Methods and Procedures

Bison testing personnel performed the following EPA methods as described in Title 40, Code of Federal Regulations (CFR), Part 60, Appendix A:

**EPA Reference Method 1, "Sample and Velocity Traverses for Stationary Sources."**

The objective of Method 1 is to determine a suitable location for testing and to determine the velocity measurement points for the source. The distance upstream to atmosphere from the sampling ports (Distance A) is measured and the distance downstream to the nearest disturbance from the sample points (Distance B) is measured. Distances A and B are applied to Method 1, Figure 1-2 for velocity measurement points. These figures give the minimum number of measurement points according to the dimensions of the source. The number of points and the stack diameter are then applied to Method 1, Table 1-2 to determine equal area measurement points within the source. The results of Method 1 location and velocity point measurement locations are included in the report appendices.

**EPA Reference Method 2, "Determination of Stack Gas Velocity and Volumetric Flow Rate (Type-S Pitot Tube)."**

The objective of Method 2 is to measure stack gas velocity, collect temperature data, and calculate a volumetric flow. Method 2 velocity measurements are performed using a Type S pitot tube. Differential pressures are measured using an inclined manometer, and temperatures are measured using a k-type thermal indicator. Bison has incorporated 0.84 as the Type S pitot tube coefficient ( $C_p$ ). The average velocity, temperature, static pressure, and source area are used to calculate volumetric flow within the source. This field data is recorded on field data sheets. Copies of the field data, results from the flow calculations, and calibration data can be found in the appendices to this report.

**Method 3A, "Determination of Oxygen and Carbon Dioxide Concentrations in Emissions from Stationary Sources (Instrumental Analyzer Procedure)."**

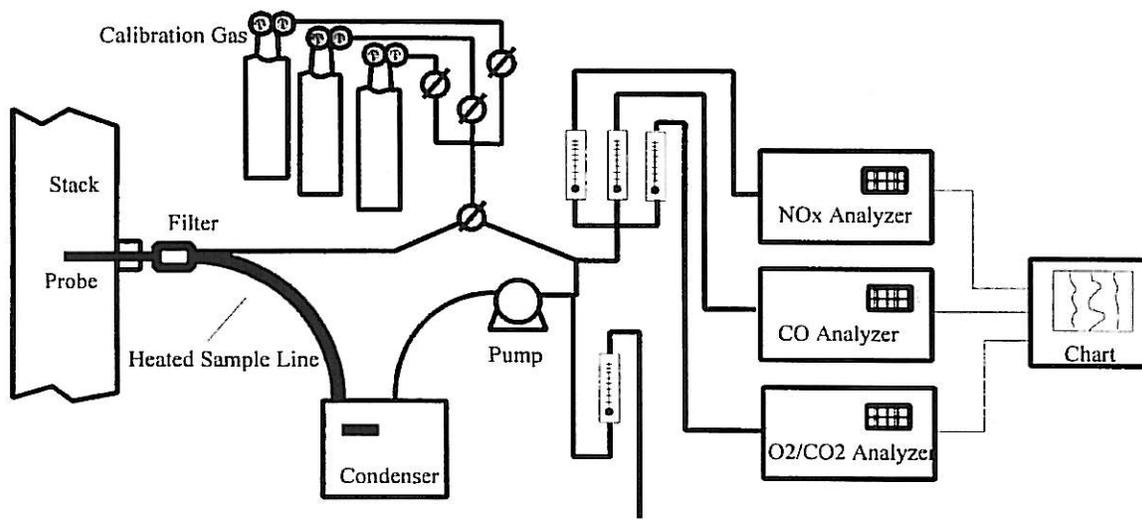
The objective of Method 3A is to determine the molecular weight of the source stream by determining oxygen ( $O_2$ ) and carbon dioxide ( $CO_2$ ) concentrations in the stack gas stream. The principle is to extract a gas sample from a stationary source and route the sample through a conditioning system to a paramagnetic oxygen analyzer and an infrared carbon dioxide analyzer for the measurement of  $O_2$  and  $CO_2$  in percentages (%). The  $O_2$  and  $CO_2$  analyzers calibration adjustments are performed by sending EPA Protocol 1 gas directly to the analyzers. A system calibration is performed by sending calibration gas to the probe and through the system to the analyzers. Bison's  $CO_2/O_2$  analyzer is a Servomex Series 1400 (Serial Numbers 01415/B198 and 014208/901, respectively). The calibration error, system bias and system drift data, and measured concentrations were

recorded on a stripchart or data acquisition system (DAS). A copy of this data is included in a report appendix.

**Method 4, "Determination of Moisture Content in the Stack Gases."** The objective of Method 4 is to determine the moisture content of a gas stream. The principle of the method is to extract a sample from the source at a constant rate and impinge it through chilled water and silica gel. The moisture is removed from the sample stream and the volume (or mass) of water extracted is determined. The sample volume and water volume (or mass) are used to calculate the moisture content of the stack gas. The results of pre- and post-test dry gas meter (DGM) calibrations can be found in the DGM calibrations table. The DGM calibration data can be found in an appendix of this report. The impinger waters are volumetrically measured on-site and the silica gels are transported to Bison's lab and weighed. The test data is hand-recorded on field data sheets and then entered into spreadsheets for moisture determination calculations. This data and the resulting moisture can be found in the appendices of this report.

**EPA Reference Method 7E, "Determination of Nitrogen Oxides Emissions from Stationary Sources."** The objective of Method 7E testing is to determine the NO<sub>x</sub> concentration from the source. Method 7E entails extraction of a gas sample from a stationary source and routing the sample through a conditioning system to an analyzer for the measurement of NO<sub>x</sub> (NO and NO<sub>2</sub>) in ppmvd. The NO<sub>2</sub> analyzer calibration adjustment is performed by sending EPA Protocol 1 gas directly to the analyzer. A system bias check is performed by sending calibration gas to the probe and through the system to the analyzer. Bison uses a Thermo Environmental 42C (NO-NO<sub>2</sub>-NO<sub>x</sub>) analyzer, Serial Number 42CHL-56022-306. The calibration error, system bias and system drift data, and measured concentrations are recorded on a stripchart or DAS for permanent record.

### Typical Layout of a Method 7E and 10 Sampling System



**EPA Reference Method 10, "Determination of Carbon Monoxide Emissions from Stationary Sources (Instrumental Analyzer Procedure)."** The objective of Method 10 is to determine the CO concentrations from the source. Method 10 entails extraction of a gas sample from a stationary source and routing the sample through a conditioning system to an analyzer for the measurement of CO in ppmvd. The CO analyzer calibration adjustment is performed by sending EPA Protocol 1 gas directly to the analyzer. A system bias check is performed by sending calibration gas to the probe and through the system to the analyzer. Bison uses a Thermo Environmental Instruments 48C CO Analyzer, Serial Number 48C-55909-305. The calibration error, system bias and system drift data, and measured concentrations are recorded on a stripchart or DAS for permanent record.

**EPA Reference Method 19, "Determination of Sulfur Dioxide Removal Efficiency and Particulate Matter, Sulfur Dioxide, and Nitrogen Oxides Emissions Rates."** Method 19 is employed for the determination of mass rate emissions. Results from Methods 3A, 7E and natural gas dry F factor ( $F_d$ ) (from Table 19-1) are employed to calculate an  $NO_x$  emission rate (E) according to the following steps.

**Step 1:** Calculate  $NO_x$  in pounds per standard cubic feet (lbs/scf). Method 19, Table 19-1, provides factors to convert ppm  $NO_x$  to lb/scf.

$$C_d = NO_x \text{ ppm} \times 1.194 \times 10^{-7} \text{ lbs/scf/ppm} = NO_x \text{ lbs/scf}$$

**Step 2:** Calculate  $NO_x$  results in pounds per hour using Table 19-2 "Factors for Various Fuels," using the  $F_d$  factors and measured oxygen ( $O_2$ ).

$$E = F_d^{\text{dscf/MMBtu}} C_d \frac{20.9}{(20.9 - \%O_2)} = NO_x \text{ lbs/MMBtu}$$

Where: E = pollutant emission rate (lbs/MMBtu)

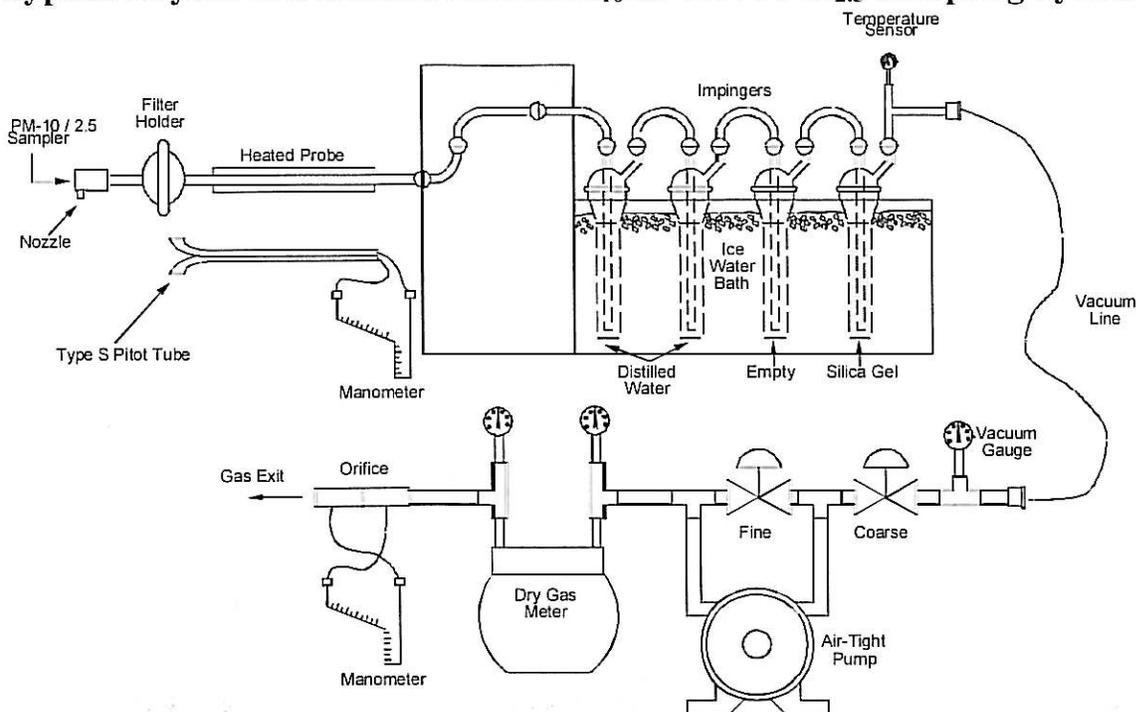
$C_d$  = pollutant concentration dry basis (lbs/scf)

**Step 3:** Using the fuel usage measured during the test and the heating factor of 969.2 Btu/scf n.g., calculate the  $NO_x$  results in pounds per hour as follows.

$$E^{\text{lbs/MMBtu}} \times 9.692 \times 10^{-4} \text{ MMBtu/scf n.g.} \times \text{fuel}^{\text{scf n.g./hr}} = NO_x \text{ lbs/hr}$$

**Conditional Test Method 40, "Determination of  $PM_{2.5}$  Emissions (Constant Sampling Rate Procedure)" (Methods 2 & 4 Inclusive).** The objective of Method CT40 is to determine the particulate matter (PM) emissions equal to or less than an aerodynamic diameter of 2.5 microns from stationary sources. The principle is to draw the sample stream through an in-stack cyclone which cuts the PM. The matter less than 2.5 microns proceeds to a 0.3 micron filter. Matter less than 0.3 microns is captured in water impingers. CT40 incorporates Method 2 "velocity measurements" and Method 4 "moisture measurements."

## Typical Layout of a Method 201A PM<sub>10</sub> or CT40 PM<sub>2.5</sub> Sampling System



### 4.3 Analytical Methods

**Chain of Custody:** Bison staff maintained possession of the samples throughout sampling, transport and analysis.

**Filter Analysis:** Bison weighed filters in an environmentally controlled room. Before field use, the filters were desiccated for a minimum of 24 hours, then weighed and desiccated at 6-hour intervals until a constant pre-test tare was achieved. After the tests, the filters were desiccated for a minimum of 24 hours, then weighed and desiccated at 6-hour intervals until constant post-test weight was achieved. The difference between the average pre-test tare and average post-test weight was the filter mass capture. Sample descriptions are recorded on the field data forms.

**Nozzle, Cyclone, Probe and Filter-bell Rinse Analysis:** The nozzle, probe and filter-bell were rinsed with acetone. The rinsate was collected in a sample bottle, transferred to a pre-conditioned, tared aluminum sample boat and heated to evaporate the acetone. The boat was again conditioned and weighed to determine "front-half" rinse particulate matter. The rinse mass capture was added to the filter particulate capture to determine "front-half" filterable PM emissions.

**Impinger Water:** Post-test impinger water description of color and presence of film are recorded on field data sheets. The impinger waters are volumetrically measured after each test run and rinsed with MeCl. The water and rinse is then transferred to uniquely identified sample containers for transport to Bison's lab. At the lab, sample containers are

checked for leakage then the waters are transferred to graduated cylinders where the volumes are checked for leakage.

***Impinger Water Organic and Inorganic Matter Analysis:*** The impinger waters are decanted into a separatory flask and 75 mls of methylene chloride (MeCl) are added and mixed well. The organic fraction is then drained off into a tared beaker and the extraction is performed one more time. The remaining inorganic fraction is drained into a tared beaker. Both beakers are then dried, desiccated and weight gain analysis is performed.

***Organic CPM, Methylene Chloride (MeCl) Extractable Matter (MCEM):*** The impinger waters are transferred to a separatory flask where MeCl is added. The flask is shaken and allowed to settle. The solution separates into two distinct aqueous solutions, and the lower solution is separated off into a tared beaker. This process is repeated. Once the solution has evaporated to less than 50 mls, the solution is transferred to a pre-conditioned, tared boat and allowed to air dry until completely evaporated. After evaporation, the boats are then placed in a desiccator for a minimum of 6 hours after which they are weighed in 6-hour intervals until a constant weight is achieved. This weight gain results in the MCEM.

***Inorganic CPM:*** The remaining water in the flask is drained into another tared beaker and placed on a warming plate to evaporate. Once the water has evaporated to less than 50 mls, the water is transferred to a pre-conditioned, tared boat and allowed to air dry until completely evaporated. After evaporation, the boats are then placed in a desiccator for a minimum of 6 hours after which they are weighed in 6-hour intervals until a constant weight is achieved.

***Silica Gel:*** Bison transports pre-dried silica gel in airtight containers holding approximately 250 grams. Each container is weighed prior to use in a sampling train. After testing, the gel is placed back into the container and reweighed for moisture gain. Pre- and post-test silica gel weights are recorded in the lab, entered into the spreadsheets and may be recorded on field data sheets.

**Fuel samples** were taken during the testing project and sent to the following lab for ultimate analysis and Btu determination. The lab results are presented in an appendix to this report.

**Hazen Research Inc.**

4601 Indiana Street

Golden, Colorado 80403

Tel. 303 279-4501

Fax 303 278-1528

Contact: Gerard H. Cunningham, Fuel Laboratory Manager

## **5.0 QUALITY ASSURANCE AND QUALITY CONTROL**

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### **5.1 Documentation and Tracking**

Bison uses a project number for document control and tracking for all projects. Each project that Bison works on is assigned a project number. All documentation pertaining to that project is filed in the same place under that project number. This assures all pertinent information can be found easily at a later date.

The tracking number for this project is **BRR208861**.

### **5.2 Sampling Protocol**

Bison's test, laboratory, reporting, and quality assurance procedures conform to the requirements specified in the *Quality Assurance Handbook for Air Pollution Measurement Systems, Vol. III, Stationary Source Specific Methods*, published by the U.S. Environmental Protection Agency in August, 1977, as revised and amended (cat. #EPA-600/4-77-027b).

The individual test methods specify handling procedures for physical samples (liquids, traps, etc.). Bison follows the procedures outlined in the appropriate methods as described in EPA 40 CFR Part 60, Appendix A and Appendix B.

### **5.3 Quality Assurance**

Bison's quality assurance program is designed to ensure that all source testing methods are followed and are performed by competent, experienced personnel. Bison's equipment is properly calibrated and maintained in good working order. Procedures for sample collection, recovery, and analysis are performed according to applicable EPA methods. Bison's practices conform to the procedures in the Environmental Protection Agency (EPA) *Quality Assurance Handbook for Air Pollution Measurement Systems, Volume 3*, EPA-600/4-77-0276, 1977, as amended.

Bison personnel calibrate equipment and instruments using standards when applicable or per the procedures of National Institute of Standards and Technology (NIST). Bison's equipment is manufactured to meet all applicable EPA criteria and parameters. Bison defines a calibration as the procedure of changing a measurement system or device to match a constant or standard measurement system or device; an "audit" checks the variance between the value and a standard or a precalibration.

Emission testing quality assurance checks and quality controls (QA/QC) require three steps: before, during, and after field testing. "Before" QA/QC procedures are performed in Bison's lab, "during" QA/QC checks are recorded on the field data sheets, and "after" QA/QC procedures are performed at Bison's lab. These data can be found in the

appendices. The following table describes Bison's QA/QC, calibration and audit procedures and schedule.

**Table 4: Equipment Calibration and Audit Procedures**

Parameter or Unit	Schedule and Requirement	Method Reference
Acetone / DI water	Blank analysis on the rinse solution.	Method 5, 3.2
Probe nozzle	Calibration according to reference.	Method 5, 5.1
Isolated Type S pitot tubes	Calibration prior to initial field use.	Method 2, 10.1
	Re-examined after each field use.	Method 2, 10.1.5.2.1
Temperature gauges	Audited on-site and/or after each field use.	Method 2, 10.3.1
Probe heater	Calibration prior to initial field use.	Method 5, 5.4
Barometer	Calibrated against Hg barometer.	Method 2, 10.4
Metering system	Calibration prior to use.	Method 5, 10.3.1
	Calibration after use.	Method 5, 10.3.2
Analytical balance	Calibrated and/or audited each year by independent auditor.	N/A
	Audited during sample weighing.	N/A
Analyzers	Analyzer calibration error, ACE.	Method 7E, 8.5
	NO <sub>2</sub> to NO conversion test.	Method 7E, 8.2.4
Sample system	Sample system bias check, SB.	Method 7E, 8.5
	Zero and calibration drift tests.	Method , 7E.8.5

#### 5.4 Volumetric Sampling Equipment Calibrations

##### Volumetric Sampling by Dry Gas Meter (DGM)

Volumetric sampling by DGM must be initially calibrated across its full operating range then audited after each testing project. The post-test audit must be within 5% of its initial calibration. Should the DGM not be within the 5% criteria, the DGM factors must be used that will give the lowest sample volume. Calibration data can be found in an appendix to this report. The following table presents the results of the pre- and post-test DGM calibrations and audits.

**Table 5: Meter Box Calibration Results**

<b>Bison Engineering Equipment Calibration Record</b>				
<b>Unit</b>	<b>Pre-Calibration</b>	<b>Post-Calibration</b>	<b>Results</b>	<b>Required</b>
Meter Box 4, "Y"	1.049	1.041	0.01%	±5% from pre-calibration

Method 5, Section 5.3.3, states that, should the pre- and post-"Y" factor calibrations differ more than 5%, the lesser "Y" value shall be used in the calculations.

## **5.5 Instrument Calibration, Maintenance and Standards**

Bison uses a field barometric pressure gauge that is calibrated prior to each field deployment against a mercury-in-glass standard barometer. Temperature calibrations are performed using a mercury-in-glass NIST-traceable thermometers.

Bison uses RATA-class calibration gases for all emission testing projects which are certified as EPA Protocol 1 gases and are purchased from Scott Specialty Gases. The calibration gas certifications are included in the appendix of this report.

Calibration adjustments of the analyzers are performed by sending the Protocol 1 gas directly to the analyzers. A system audit is performed before and after each test run by sending calibration gas to the probe and through the system to the analyzers. The results of these calibrations and audits can be found in the spreadsheets located in the appendices.

## **5.6 Data Acquisition, Reduction and Validation**

Test data such as velocities, temperatures and isokinetic sampling are hand-recorded on field data sheets. The data is then entered into computer spreadsheets where QC/QA and emission calculations are performed according to the methods. An appendix of this report contains nomenclature and formulae for reference. All raw field data is supplied in an appendix to this report. The appendix contains some example calculations; additional examples will be supplied upon request.

### **Rounding of Significant Figures**

If the first digit to be discarded is less than five, the last digit retained should not be changed. When the first digit discarded is greater than five, or if it is a five followed by at least one digit other than 0, the last figure retained should be increased by one unit. When the first digit discarded is exactly five, followed only by zeros, the last digit retained should be rounded upward if it is an odd number, but no adjustment made if it is an even number.

For example, if the emission standard is 90, than 90.357 would be rounded to 90, 90.639 would be rounded to 91, 90.500 would be rounded to 90, and 91.500 would be rounded to 92.

<b>Standard</b>	<b>Number</b>	<b>Rounded To</b>
90	90.357	90
90	90.639	91
90	91.500	92

**APPENDIX A:**  
**LOW-FIRE PM TEST DATA**

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**Method 201A Spreadsheet  
Method 201A PM<sub>10</sub> & CT40 PM<sub>2.5</sub> Test**

COMPANY	Bitter Root
FACILITY	Victor School
LOCATION	Victor, MT
SOURCE	Boiler, Low Fire
DATE	Feb 12, 08

Method 201A PM10 & CT Method 40 PM2.5

Client	Bitter Root		Number of Runs 2
Facility	Victor School		
Location	Victor, MT		
Source	Boiler, Low Fire		
Test date	Feb 12, 08	Feb 12, 08	
Start time	15:33	17:11	
Test run	One	Two	

Preliminary info			
Barometric pressure [Bp]	"Hg	26.67	26.67
Stack Diameter	inch	14	14
stack exit area	sqft	1.07	1.07
Meter box ID		2	2
meter box Yi		1.003	1.003
meter box delta H@		1.76	1.76
Pitot tube coefficient Cp		0.84	0.84

Test Information			
nozzle size [nz]	inch	0.35	0.35
filter number		2443	2443
Sample points		12	12
Test duration	min	48	48
Isokinetics [i]	%	118	113
D50 cut rate		10.20	10.19
Sample volume, eq 4.3	dscf	18.47	17.09
avg delta P	"H2O	0.039	0.039
avg sqrt delta P	"H2O	0.197	0.197
201A Constant sample rate delta H	"H2O	0.46	0.48
CT40 Constant sample rate delta H	"H2O	0.42	0.43
avg meter temp [Tm]	deg F	62.3	66.7

Stack Information				AVERAGES
avg stack temp [ts]	deg F	262	274	268
avg ABS stack temp [Ts]	deg R	722	734	728
actual stack flow	acfm	889	896	893
actual stack velocity [Vs]	ft/sec	13.9	14.0	14
Standard stack flow	dscfm	507	503	505
Standard stack flow	dscf/hr	30415	30160	30287
stack moisture [bws], eq 4.4	% v/v	12.61	12.59	13
measured static pressure	"H2O	0	0	0
stack static pressure [ps]	"Hg	26.67	26.67	26.67
Oxygen content	%O2	14.5	14.1	14
Carbon dioxide content	%CO2	6.5	6.9	7
Wet (Actual) Molecular Weight, Ms	lb/lb.mole	28.2	28.2	28.2
Dry Molecular Weight, Md	lb/lb.mole	29.6	29.7	29.6

Lab Information			
Impinger H2O Gain	mls	51	46
Impinger H2O volume [Vwc(STD)], eq 4.1	scf	2.40	2.17
Silica Gel H2O Gain	grams (g)	5.63	6.28
Silica Gel volume [Vsg(STD)], eq 4.2	scf	0.27	0.30
Lab Data, cyclone > PM2.5 weight gain	g	0.0115	0.0114
Lab Data, cyclone PM2.5 weight gain	g	0.0001	0.0160
Lab Data, Filter PM2.5 weight gain	g	0.0161	0.0136
Lab data condensible PM (CPM)	g	0.0029	0.0005
Lab data MeCl Matter (MCEM)	g	0.0015	0.0017
cyclone > PM2.5 weight gain	grains (gr)	0.1775	0.1759
cyclone PM2.5 weight gain	gr	0.0015	0.2469
Filter PM2.5 weight gain	gr	0.2485	0.2099
condensible PM (CPM)	gr	0.0448	0.0077
MeCl Matter (MCEM)	gr	0.0231	0.0262

Grain loading Emissions				AVERAGES
> PM2.5 cut	gr/dscf	0.0096	0.0103	0.0100
PM 2.5 cyclone & filter	gr/dscf	0.0135	0.0267	0.0201
condensible PM (CPM)	gr/dscf	0.0024	0.0005	0.0014
MeCl Matter (MCEM-CPM)	gr/dscf	0.0013	0.0015	0.0014
EPA PM2.5 + CPM	gr/dscf	0.0172	0.0287	0.0230
Total PM	gr/dscf	0.0268	0.0390	0.0329

Mass Rate Emissions				AVERAGES
> PM2.5 cut	lbs/hr	0.042	0.044	0.0430
PM 2.5 cyclone & filter	lbs/hr	0.059	0.115	0.0870
condensible PM (CPM)	lbs/hr	0.011	0.002	0.0062
MeCl Matter (MCEM-CPM)	lbs/hr	0.005	0.007	0.0060
EPA PM2.5 + CPM	lbs/hr	0.075	0.124	0.0992
Total PM	lbs/hr	0.117	0.168	0.1423

Emission Factor				AVERAGES
lab analysis Fd @ 0% oxygen	dscf/MMBtu @ 0%	9399	9399	9399
lab analysis Fd @ stack conditions	dscf/MMBtu @ SK	30694	28888	29791
EPA PM2.5 + CPM	lbs/MMBtu	0.075	0.119	0.0970
TPM	lbs/MMBtu	0.118	0.161	0.1393

Boiler operating rate	MMBtu/hr	0.99	1.04	1.0175
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**Test Run 1**      **Bison Engineering, Method 201A PM<sub>10</sub> & CT40 PM<sub>2.5</sub> Spreadsheet**

Data by   jw        Checked by   cwl  

Facility:	Blifter Root	Location:	Victor, MT	Date:	Feb 12, 08
Operators:	jw, mtc	Filter #	2443	Source:	Boiler, Low Fire
				Start time:	15:33
				End time:	

**PRELIMINARY INFO.**

Pm Bp	26.67	( <sup>3</sup> Hg)
Diam	14	Width
Stack AREA	1.07	Rect. sqft
Meter Box	1.003	Yt
Delta H@	1.76	Delta H@

**PRE TEST INFO**

Assumed moisture	10.1	(%)
Assumed Meter Temp	55.0	(deg F)
Target Run Time	48.0	(min)
Total Number of Points	12	

**TRAVERSE INFO**

Pg Static, gage pressure	0.00	( <sup>3</sup> H2O)
Stack Temp, Is	245.0	(deg F)
O <sub>2</sub> Abs stack Temp, Ts	705	(deg R)
CO <sub>2</sub> Oxygen, dry	14.5	(% v/v d)
Oxygen, wet	13.0355	(% v/v d)
Carbon Dioxide, dry	6.5	(% v/v d)
Molecular weight, dry	29.62	(lb/lb.mole)
Molecular weight, wet	28.44638	(lb/lb.mole)

**201A Calculations**

us 201A stack viscosity	217.10	(micropoise)
Qs 201A Cyclone flow rate	0.603	(ft <sup>3</sup> /min)
ΔH 201A Delta H ==>	0.46	( <sup>3</sup> H2O)
RANGE	0.40	-50 °F
	0.53	+50 °F

**CT40 Calculations**

us CT40 stack viscosity	214.08	(micropoise)
C Cunningham Corr. Factor	1.10	
D <sub>50LL</sub> Lower limit cut diameter	9.46	(micrometers)
D <sub>50T</sub> Cut diam for cyclone	10.23	(micrometers)
Qs CT40 Cyclone flow rate	0.576	(ft <sup>3</sup> /min)
Nre Reynolds number	2500	Nre < 3162 *
ΔH CT40 Delta H ==>	0.42	( <sup>3</sup> H2O)
RANGE	0.36	-50 °F
	0.48	+50 °F

**NOZZLE SELECTION**

Nd	201A	•136	•15	•164	•182	•197	•215	•233	•264	•3	•342	•39		
CT40	N1	•125	N2	•138	N3	•156	N4	•172	N5	•188	N6	•20 N7	•22 N8	•25
H <sub>2</sub> O Nozzle Diameter estamale	0.359	Selected >	0.35											
H <sub>2</sub> O delta P (min)	ERR	AVG	ERR	ERR	AVG	ERR	AVG	ERR	AVG	ERR	AVG	ERR		
H <sub>2</sub> O delta P (max)	NA	ERR	NA	ERR	NA	ERR	NA	ERR	NA	ERR	NA	ERR		
H <sub>2</sub> O Alt - delta P (min)	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR		
H <sub>2</sub> O Alt - delta P (max)	0.106	ERR	0.097	ERR	0.097	ERR	0.097	ERR	0.097	ERR	0.097	ERR		

**POST TEST INFO**

Impinger water	51	Silica gel	5.63	(g)
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**CALCULATED RESULTS**

Ps Stack pressure, Ps	26.67	( <sup>3</sup> Hg)
Bws % H <sub>2</sub> O in Stack	12.61	(Bws)
Mw Actual Wet Molecular Weight	28.15	(lb/lb.mole)
Vs Dry STD sample Volume	18.47	(dscf)
Final Sampling Time	49.5	(min)
us Post test stack viscosity	219.77	(micropoise)
C Post test Cunningham corr. factor	1.11	
D <sub>50LL</sub> Post test lower limit cut diameter	9.41	(micrometers)
D <sub>50T</sub> Post test cut diam for cyclone	10.20	(micrometers)
Qs std Post test cyclone flow rate	0.60	(ft <sup>3</sup> /min)
I Isokinetic Avg. (80 < I < 120)	118	(%)
D50 D50 Cut Rate. (9 < d50 < 11)	10.2	(um)

Revised Sept 08/01 by CWL

Test No	Pre traverse		Point Time	Run Time	MetVol	Vel head		Stack Temp		Meter Temp		Assumed % I	Actual % I	Rolling % I	Vel. ft/sec	Flow acfm	Flow dscfm
	dP	sqrt dP				delta P	sqrt dP	In	Out	In	Out						
1	0.043	0.21	4.2	4.2	732.37	0.040	0.20	261	58	58.5	116.78	120	120	14.07	903	515	
2	0.038	0.19	4.2	8.4	735.930	0.040	0.20	261	59	59.5	116.55	120	120	14.07	903	515	
3	0.041	0.20	4.2	12.6	737.780	0.040	0.20	261	62	60.5	120.90	124	121	14.07	903	515	
4	0.039	0.20	4.1	16.7	739.480	0.039	0.20	261	62	60.5	115.26	119	121	13.90	891	508	
5	0.039	0.20	4.1	20.8	741.170	0.039	0.20	269	63	61.5	114.99	118	120	13.97	896	506	
6	0.038	0.19	3.9	24.7	742.750	0.034	0.18	261	64	62	120.27	124	121	12.98	832	475	
7	0.034	0.18	4.0	28.7	744.360	0.036	0.19	261	65	63	115.90	119	121	13.35	856	489	
8	0.036	0.19	4.1	32.8	745.810	0.038	0.19	261	66	64	98.93	102	118	13.72	880	502	
9	0.038	0.19	4.1	36.9	747.320	0.038	0.19	261	66	64	103.02	106	117	13.72	880	502	
10	0.038	0.19	4.1	41.0	748.920	0.039	0.20	261	66	64.5	107.65	111	116	13.90	891	508	
11	0.040	0.20	4.1	45.1	750.460	0.039	0.20	261	67	65	103.52	106	115	13.90	891	508	
12	0.044	0.21	4.4	49.5	752.780	0.044	0.21	261	67	65	136.81	141	117	14.76	947	540	
	avg dP	avg. [dP	sample volume		20.410	avg. dP	avg. [dP	Ts	Tm						acfm	dscfm	
	0.039	0.197				0.039	0.197	261.67	62.33	Im °F					889	507	
	avg sqrt dP squared	0.039				721.67	Ts °R		522.33	Tm °R							

S T A C K

**CT040 TEST METHOD CALCULATIONS**  
Test Run 1

ts	Ts	O2 dry	O2 wet	Bws	Ps	Mw	Md	Pbar	Tm	ΔH@
245	705	14.50	13.04	0.101	26.67	28.44638	29.62	26.67	515	1.76

Eq. 3 CT040 viscosity

C1	C2	C3	C4	C5	C6
-150.3162	13.4622	3.86E+06	0.591123	91.9723	1.52E-05

$$u = C1 + C2 (\text{sqrt } Ts) + C3 Ts^2 + C4 (\%O_2 \text{ wet}) - C5 Bws + C6 Bws Ts^2$$

C1	C2	sqrt Ts	C3	Ts ^2	C4	%O2 wet	C5	Bws	C6	Bws	Ts^2
-150.3162	13.4622	26.55184	3861530	2.01E-06	0.591123	13.0355	91.9723	0.101	1.52E-05	0.101	497025

u = 214.08 micropoise

Eq. 4 Cunningham Correction Factor

$$C = 1 + 0.0057193 (u/Ps/Dp) (Ts/Mw)^{0.5}$$

u	Ps	Dp	Ts	Mw
214.0774	26.67	2.25	705	28.44638

C = 1 0.005719 3.567511 4.9783

C = 1.10

Eq. 5 Lower Limit Cut Diameter

$$D_{50LL} = 9.057 C^{0.3007} (Mw \cdot Ps / Ts)^{0.1993}$$

D <sub>50LL</sub> =	9.057	1.101576	0.3007	28.44638	26.67	0.1993
					705	

D<sub>50LL</sub> = 9.462

Eq. 6 Cut Diameter for Cyclone I for the Middle of the Overlap Zone

$$D_{50T} = (11 + D_{50LL}) / 2$$

Q<sub>s</sub> = 0.576 ft<sup>3</sup>/min

Eq. 8 Reynolds Number

$$Nre = 8.64 \times 10^5 (Ps \cdot Mw / Ts) (Qs / u)$$

	8.64E+05	26.67	28.44638	0.575537
		705	214.0774	

Nre = 864000 1.076121 0.002688

Nre = 2500

If Nre < 3162 use eq.9 to calculate ΔH  
If Nre > 3162 recalculate D<sub>50LL</sub> using Eq.10

Eq. 9 Meter Box Orifice Pressure Drop SAME AS 201A

$$\Delta H = (Qs (1 - Bws) Ps / Ts)^2 (1.083 Tm Md \Delta H@ / Pbar)$$

ΔH =	0.575537	0.899	26.67	2	1.083	515	29.62	1.76
		705				26.67		

ΔH = 0.000383 1090.211

ΔH = 0.42 +50 °F ΔH = 0.36 0.000334  
-50 °F ΔH = 0.48 0.000444

Eq. 10 Recalculated Lower Limit Cut Diameter @ Nre > 3162

$$D_{50LL} = 10.0959 C^{0.44} (Mw \cdot Ps / Ts)^{0.06}$$

D <sub>50LL</sub> =	10.0959	1.101576	0.44	28.44638	26.67	0.06
		705				

D<sub>50LL</sub> = 10.581

Re Eq. 6 Recalculated Cut Diameter for Cyclone I for the Middle of the Overlap Zone @ Nre > 3162

$$D_{50T} = (11 + D_{50LL}) / 2$$

	11	10.581	2
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D<sub>50T</sub> = 10.79

Re Eq. 7 Recalculated Cyclone Sampling Rate @ Nre > 3162

$$Qs = 0.07296 u (Ts/Mw/Ps)^{0.2949} (1/D_{50T})^{1.4102}$$

Qs =	0.07296	214.0774	705	0.2949	1	1.4102
		28.44638	26.67		10.7905	

Qs = 0.07296 214.0774 0.978598 0.03493

Re Qs = 0.53 ft<sup>3</sup>/min

**Test Run 2**      **Bison Engineering, Method 201A PM<sub>10</sub> & CT40 PM<sub>2.5</sub> Spreadsheet**

Data by   jw   Checked by   CWL  

Facility:	Bitter Root	Location:	Victor, MT	Date:	Feb 12, 08
Operators:		Filter #	2443	Source:	Boiler, Low Fire
				Start time:	17:11
				End time:	

**PRELIMINARY INFO.**

Pm Bp	26.67	( <sup>3</sup> Hg)
Diam	0	Width
Length	14	Rect. sqft
Stack AREA	1.07	0
Meter Box	1.003	(sqft)
Y1	1.76	
Delta H@2		

**PRE TEST INFO**

Assumed moisture	10.1	(%)
Assumed Meter Temp	75.0	(deg F)
Target Run Time	48.0	(min)
Total Number of Points	12	

**TRAVERSE INFO**

Pg Static, gage pressure	0.00	( <sup>3</sup> H2O)
Stack Temp, is	245.0	(deg F)
O <sub>2</sub> Abs stack Temp, Ts	705	(deg R)
CO <sub>2</sub> Oxygen, dry	14.1	(% v/v d)
Oxygen, wet	12.6759	(% v/v w)
Carbon Dioxide, dry	6.9	(% v/v d)
Molecular weight, dry	29.668	(lb/lb.mole)
Molecular weight, wet	28.489532	(lb/lb.mole)

**201A Calculations**

us 201A stack viscosity	216.89	(micropoise)
Qs 201A Cyclone flow rate	0.602	(ft <sup>3</sup> /min)
ΔH 201A Delta H ==>	0.48	( <sup>3</sup> H2O)
RANGE	0.41	-50 °F
	0.55	+50 °F

**CT40 Calculations**

us CT40 stack viscosity	213.87	(micropoise)
C Cunningham Corr. Factor	1.10	
D <sub>50LL</sub> Lower limit cut diameter	9.46	(micrometers)
D <sub>50T</sub> Cut diam for cyclone	10.23	(micrometers)
Qs CT40 Cyclone flow rate	0.575	(ft <sup>3</sup> /min)
Nre Reynolds number	2502	Nre < 3162 *
ΔH CT40 Delta H ==>	0.43	( <sup>3</sup> H2O)
RANGE	0.38	-50 °F
	0.50	+50 °F

**NOZZLE SELECTION**

Nd	1.136 * 15 * 164 * 182 * 197 * 215 * 233 * 264 * 3 * 342 * 39	
CT40	N1*125 N2*138 N3*156 N4*172 N5*188 N6*20 N7*22 N8*25	
H <sub>2</sub> O Nozzle Diameter estimate	0.359	Selected >
H <sub>2</sub> O delta P (min)	ERR	AVG
H <sub>2</sub> O delta P (max)	NA	ERR
H <sub>2</sub> O Alt - delta P (min)	ERR	ERR
H <sub>2</sub> O Alt - delta P (max)	0.106	ERR

**POST TEST INFO**

Impinger water	46	Silica gel	6.28	(g)
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**CALCULATED RESULTS**

Ps Stack pressure, Ps	26.67	( <sup>3</sup> Hg)
Bws % H <sub>2</sub> O in Stack	12.59	(Bws)
Mw Actual Wet Molecular Weight	28.20	(lb/lb.mole)
Vs Dry STD sample Volume	17.09	(dscf)
Final Sampling Time	48.3	(min)
us Post test stack viscosity	222.82	(micropoise)
C Post test Cunningham corr. factor	1.11	
D <sub>50LL</sub> Post test lower limit cut diameter	9.39	(micrometers)
D <sub>50T</sub> Post test cut diam for cyclone	10.19	(micrometers)
Qs std Post test cyclone flow rate	0.61	(ft <sup>3</sup> /min)
I Isokinetic Avg. { 80 < I < 120 }	113	(%)
D50 D50 Cut Rate. { 9 < d50 < 11 }	10.2	(um)

Revised Sept 08/01 by CWL

Test No	Pre traverse		Point Time	Run Time	MetVol	Vel head		Stack Temp		Meter Temp		Assumed % I	Actual % I	Rolling % I	Vel. f/Sec	Flow acfm	Flow dscfm
	dP	sqrt dP				delta P	sqrt dP	delta H	Temp	In	Out						
1	0.040	0.20	4.1	4.1	752.94	0.040	0.20	268	64	63	63.5	111.79	115	115	14.13	906	512
2	0.040	0.20	4.1	8.2	754.610	0.040	0.20	268	64	64	64	102.32	105	110	14.13	906	512
3	0.040	0.20	4.0	12.2	756.140	0.039	0.20	269	65	64	64.5	101.33	104	108	13.96	896	505
4	0.039	0.20	4.0	16.2	757.600	0.039	0.20	270	66	65	65.5	108.83	112	109	13.97	896	505
5	0.039	0.20	4.0	20.2	760.720	0.038	0.19	275	68	65	66.5	109.01	112	110	13.84	888	497
6	0.034	0.18	3.9	24.1	762.430	0.036	0.19	277	69	67	68	126.54	130	113	13.49	865	483
7	0.036	0.19	3.9	28.0	764.110	0.037	0.19	277	70	68	69	122.40	126	115	13.67	877	490
8	0.038	0.19	4.0	32.0	765.680	0.039	0.20	277	70	68	69	108.63	112	115	14.04	900	503
9	0.038	0.19	4.0	36.0	767.280	0.038	0.19	277	70	67	68.5	112.26	115	115	13.86	889	496
10	0.039	0.20	4.1	40.1	768.810	0.040	0.20	275	69	66	67.5	102.13	105	114	14.20	911	510
11	0.039	0.20	4.0	44.1	770.350	0.039	0.20	275	69	66	67.5	106.71	110	113	14.02	899	503
12	0.044	0.21	4.2	48.3	771.980	0.041	0.20	275	68	65	66.5	105.11	108	113	14.37	922	516
avg dP	avg. dP	avg. [dP]	sample volume		19.040	avg. dP	avg. [dP]	Ts	Tm						f/Sec	acfm	dscfm
	0.039	0.197				0.039	0.197	733.58	66.67	66.67	Im °F				13.97	896	503
avg sqrt dP squared	0.039							733.58	526.67	526.67	Tm °R						

**S T A C K**

Sample Identification	Filter #	Date	Tare 1 (g)	Date	Tare 2 (g)	CHECK	Average	Filter #	Date	Final 1 (g)	Date	Final 2 (g)	CHECK	Average	Gain
Victor 12-13-08 Run 1	2943	9/24/2007	0.3469	10/16/2007	0.3471	0.0002	0.3470	2943	2/15/2008	0.3630	2/21/2008	0.3631	0.0001	0.3631	0.0161
Victor 12-13-08 Run 2	2944	9/24/2007	0.3472	10/16/2007	0.3473	0.0001	0.3473	2944	2/15/2008	0.3607	2/21/2008	0.3610	0.0003	0.3609	0.0136
Victor 12-13-08 Run 3	2945	9/24/2007	0.3469	10/16/2007	0.3470	0.0001	0.3470	2945	2/15/2008	0.3775	2/21/2008	0.3777	0.0002	0.3776	0.0307
Victor 2/13/08 Run 4	2952	9/24/2007	0.3429	10/16/2007	0.3431	0.0002	0.3430	2952	2/15/2008	0.3748	2/21/2008	0.3749	0.0001	0.3749	0.0319

Vol (ml)	Sample Identification	Pan #	Date	Tare 1 (g)	Date	Tare 2 (g)	CHECK	Average	Pan #	Date	Final 1 (g)	Date	Final 2 (g)	CHECK	Average	Gain
19.7	Victor School + 2.5 Micron Run 1	1378	1/29/2008	2.5411	2/8/2008	2.5409	-0.0002	2.5410	1378	2/15/2008	2.5526	2/20/2008	2.5523	-0.0003	2.5525	0.01145
21.2	Victor School + 2.5 Micron Run 2	1379	1/29/2008	2.5249	2/8/2008	2.5249	0.0000	2.5249	1379	2/15/2008	2.5363	2/20/2008	2.5362	-0.0001	2.5363	0.01135
31.6	Victor School + 2.5 Micron Run 3	1380	1/29/2008	2.5163	2/8/2008	2.5164	0.0001	2.5164	1380	2/15/2008	2.5526	2/20/2008	2.5525	-0.0001	2.5526	0.03620
27.9	Victor School + 2.5 Micron Run 4	1381	1/29/2008	2.5239	2/8/2008	2.5238	-0.0001	2.5239	1381	2/15/2008	2.5535	2/20/2008	2.5533	-0.0002	2.5534	0.02985
48.5	Victor School - 2.5 Micron Run 1	1387	1/29/2008	2.5317	2/8/2008	2.5317	0.0000	2.5317	1387	2/15/2008	2.5319	2/22/2008	2.5318	-0.0001	2.5319	0.00015
70.7	Victor School - 2.5 Micron Run 2	1388	1/29/2008	2.5292	2/8/2008	2.5289	-0.0003	2.5291	1388	2/15/2008	2.5453	2/22/2008	2.5451	-0.0002	2.5452	0.01615
72.4	Victor School - 2.5 Micron Run 3	1389	1/29/2008	2.5341	2/8/2008	2.5342	0.0001	2.5342	1389	2/15/2008	2.5364	2/22/2008	2.5361	-0.0003	2.5363	0.00210
53.9	Victor School - 2.5 Micron Run 4	1390	1/29/2008	2.5336	2/8/2008	2.5335	-0.0001	2.5336	1390	2/15/2008	2.5355	2/22/2008	2.5357	0.0002	2.5356	0.00205
100	H2O Blank from Box	1391	1/29/2008	2.5289	2/8/2008	2.5289	0.0000	2.5289	1391	2/15/2008	2.5326	2/22/2008	2.5328	0.0002	2.5327	0.00375
100	H2O Blank from bottle	1392	1/29/2008	2.5220	2/8/2008	2.5220	0.0000	2.5220	1392	2/15/2008	2.5270	2/22/2008	2.5272	0.0002	2.5271	0.00510
100	Acetone Blank	1393	1/29/2008	2.5287	2/8/2008	2.5287	0.0000	2.5287	1393	2/15/2008	2.5277	2/18/2008	2.5277	0.0000	2.5277	-0.00100
100	H2O Blank	1394	1/29/2008	2.5192	2/7/2008	2.5193	0.0001	2.5193	1394	2/15/2008	2.5211	2/18/2008	2.5210	-0.0001	2.5211	0.00180
	Victor Impingers Run 1	1411	2/7/2008	2.5043	2/11/2008	2.5043	0.0000	2.5043	1411	2/20/2008	2.5073	2/21/2008	2.5072	-0.0001	2.5073	0.00295
	Victor Impingers Run 2	1412	2/7/2008	2.5853	2/11/2008	2.5854	0.0001	2.5854	1412	2/20/2008	2.5860	2/21/2008	2.5860	0.0000	2.5860	0.00065
	Victor Impingers Run 3	1413	2/7/2008	2.5686	2/11/2008	2.5683	-0.0003	2.5685	1413	2/20/2008	2.5698	2/21/2008	2.5698	0.0000	2.5698	0.00135
	Victor Impingers Run 4	1414	2/7/2008	2.5266	2/11/2008	2.5264	-0.0002	2.5265	1414	2/20/2008	2.5270	2/21/2008	2.5268	-0.0002	2.5269	0.00040
	Victor Methylene Chloride Run 1	1420	2/7/2008	2.5920	2/11/2008	2.5919	-0.0001	2.5920	1420	2/20/2008	2.5935	2/21/2008	2.5936	0.0001	2.5936	0.00160
	Victor Methylene Chloride Run 2	1421	2/7/2008	2.5728	2/11/2008	2.5729	0.0001	2.5729	1421	2/20/2008	2.5747	2/21/2008	2.5747	0.0000	2.5747	0.00185
	Victor Methylene Chloride Run 3	1422	2/7/2008	2.5388	2/11/2008	2.5388	0.0000	2.5388	1422	2/20/2008	2.5408	2/21/2008	2.5407	-0.0001	2.5408	0.00195
	Victor Methylene Chloride Run 4	1423	2/7/2008	2.5350	2/11/2008	2.5348	-0.0002	2.5349	1423	2/20/2008	2.5362	2/21/2008	2.5362	0.0000	2.5362	0.00130
	Water Blank	1424	2/7/2008	2.5301	2/11/2008	2.5301	0.0000	2.5301	1424	2/20/2008	2.5364	2/21/2008	2.5366	0.0002	2.5365	0.00640
	Acetone Blank	1425	2/7/2008	2.5414	2/11/2008	2.5413	-0.0001	2.5414	1425	2/20/2008	2.5424	2/21/2008	2.5424	0.0000	2.5424	0.00105
	Methylene Chloride Blank	1426	2/7/2008	2.5346	2/11/2008	2.5349	0.0003	2.5348	1426	2/20/2008	2.5348	2/21/2008	2.5346	-0.0002	2.5347	-0.00005

**APPENDIX B:**  
**LOW-FIRE NO<sub>x</sub> AND CO TEST DATA**

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**Victor Low Fire NOx CO test data**

		<b>Run 1</b>	<b>Run 2</b>	<b>Avg.</b>
<b>Stack Flow</b>	<b>dscfh</b>	30415	30160	<b>30287</b>
<b>Heat input</b>	<b>MMBtu/hr</b>	0.99	1.04	<b>1.0</b>
<b>NOx source concentration</b>	<b>ppmvd</b>	41.4	44.9	<b>43.2</b>
<b>NOx concentration, M19 conversion</b>	<b>lbs/dscf</b>	4.927E-06	5.343E-06	<b>5.135E-06</b>
<b>NOx mass rate</b>	<b>lbs/hr</b>	0.150	0.161	<b>0.155</b>
<b>NOx emission factor</b>	<b>lbs/MMBtu</b>	0.151	0.154	<b>0.153</b>
<b>CO source concentration</b>	<b>ppmvd</b>	219.5	191.0	<b>205.3</b>
<b>CO concentration, M19 conversion</b>	<b>lbs/dscf</b>	1.595E-05	1.388E-05	<b>1.492E-05</b>
<b>CO mass rate</b>	<b>lbs/hr</b>	0.485	0.419	<b>0.452</b>
<b>NOx emission factor</b>	<b>lbs/MMBtu</b>	0.490	0.401	<b>0.445</b>

## Victor School, NOx, CO Test Data

Date/Time mm/dd/yy hh:mm:ss	RUN CO ppm	RUN NOx ppm	RUN O2 %
02/12/08 15:33:37	212.0	46.7	14.7
02/12/08 15:33:47	243.7	47.6	14.8
02/12/08 15:33:57	234.1	45.8	14.4
02/12/08 15:34:07	204.9	44.1	14.3
02/12/08 15:34:17	180.3	45.3	14.5
02/12/08 15:34:27	158.9	46.4	14.6
02/12/08 15:34:37	132.0	45.3	14.3
02/12/08 15:34:47	107.0	44.0	14.5
02/12/08 15:34:57	104.4	45.2	15.7
02/12/08 15:35:07	178.6	46.4	16.4
02/12/08 15:35:17	397.7	36.4	16.4
02/12/08 15:35:27	620.8	26.2	16.5
02/12/08 15:35:37	756.3	20.6	16.6
02/12/08 15:35:47	788.1	15.3	16.8
02/12/08 15:35:57	721.1	13.9	17.0
02/12/08 15:36:07	605.8	12.4	17.5
02/12/08 15:36:17	467.2	13.0	17.9
02/12/08 15:36:27	378.3	13.3	17.8
02/12/08 15:36:37	360.1	12.7	18.0
02/12/08 15:36:47	365.2	12.4	18.1
02/12/08 15:36:57	364.9	11.5	18.3
02/12/08 15:37:07	359.3	10.9	18.5
02/12/08 15:37:17	358.5	10.3	18.7
02/12/08 15:37:27	364.5	9.5	18.8
02/12/08 15:37:37	378.9	8.3	18.9
02/12/08 15:37:47	400.2	7.1	19.0
02/12/08 15:37:57	426.9	6.2	19.2
02/12/08 15:38:07	457.8	5.3	19.3
02/12/08 15:38:17	506.0	4.7	19.3
02/12/08 15:38:27	555.3	4.1	19.4
02/12/08 15:38:37	584.7	3.9	19.5
02/12/08 15:38:47	601.7	3.9	19.5
02/12/08 15:38:57	615.0	3.6	19.6
02/12/08 15:39:07	629.1	3.6	19.3
02/12/08 15:39:17	679.5	3.5	18.5
02/12/08 15:39:27	782.8	3.6	18.4
02/12/08 15:39:37	787.8	7.7	18.4
02/12/08 15:39:47	775.5	11.8	18.5
02/12/08 15:39:57	807.7	12.1	18.4
02/12/08 15:40:07	881.4	12.4	17.8
02/12/08 15:40:17	827.3	13.3	17.0
02/12/08 15:40:27	678.7	13.8	16.4
02/12/08 15:40:37	643.0	18.9	15.9
02/12/08 15:40:47	615.6	23.5	15.7
02/12/08 15:40:57	514.5	27.4	15.9
02/12/08 15:41:07	417.5	30.9	15.9
02/12/08 15:41:17	379.5	30.0	15.5
02/12/08 15:41:27	406.9	28.8	15.1
02/12/08 15:41:37	385.7	33.1	15.0
02/12/08 15:42:07	184.0	39.5	14.3
02/12/08 15:42:17	247.4	38.9	14.4
02/12/08 15:42:27	274.0	38.4	14.5

02/12/08 15:42:37	265.3	39.3	14.3
02/12/08 15:42:47	256.0	39.9	14.3
02/12/08 15:42:57	227.0	40.8	14.3
02/12/08 15:43:07	198.0	41.7	14.5
02/12/08 15:43:17	213.2	42.3	14.8
02/12/08 15:43:27	226.5	42.9	14.8
02/12/08 15:43:37	221.9	41.1	14.7
02/12/08 15:43:47	227.9	39.6	14.7
02/12/08 15:43:57	250.8	39.8	14.8
02/12/08 15:44:07	266.8	39.9	14.8
02/12/08 15:44:17	267.5	38.4	14.8
02/12/08 15:44:27	303.2	36.6	14.7
02/12/08 15:44:37	330.4	37.2	14.5
02/12/08 15:44:47	277.3	38.1	14.3
02/12/08 15:44:57	236.5	40.2	14.2
02/12/08 15:45:07	265.3	42.2	14.0
02/12/08 15:45:17	286.6	41.7	13.9
02/12/08 15:45:27	295.2	41.4	13.9
02/12/08 15:45:37	280.3	43.2	14.0
02/12/08 15:45:47	217.2	45.0	14.3
02/12/08 15:45:57	173.9	45.0	14.7
02/12/08 15:46:07	202.8	44.7	14.8
02/12/08 15:46:17	249.9	42.6	14.6
02/12/08 15:46:27	298.0	40.5	14.8
02/12/08 15:46:37	331.2	38.7	15.2
02/12/08 15:46:47	348.1	37.2	14.9
02/12/08 15:46:57	313.2	36.6	14.4
02/12/08 15:47:07	254.8	36.0	14.2
02/12/08 15:47:17	218.4	39.0	14.4
02/12/08 15:47:27	224.6	42.1	14.6
02/12/08 15:47:37	290.7	42.0	14.9
02/12/08 15:47:47	330.9	42.0	14.8
02/12/08 15:47:57	310.2	41.3	14.7
02/12/08 15:48:07	274.9	40.8	14.5
02/12/08 15:48:17	237.7	41.1	14.3
02/12/08 15:48:27	192.3	41.4	13.9
02/12/08 15:48:37	170.3	43.1	13.9
02/12/08 15:48:47	182.5	44.9	14.2
02/12/08 15:48:57	204.8	45.5	14.3
02/12/08 15:49:07	211.7	46.1	14.1
02/12/08 15:49:17	221.9	45.5	13.7
02/12/08 15:49:27	205.2	45.0	13.5
02/12/08 15:49:37	154.4	46.7	13.5
02/12/08 15:49:47	112.4	48.5	13.4
02/12/08 15:49:57	98.7	48.5	13.5
02/12/08 15:50:07	106.4	48.5	13.4
02/12/08 15:50:17	129.2	48.2	13.5
02/12/08 15:50:27	163.9	48.2	13.5
02/12/08 15:50:37	189.6	48.8	13.7
02/12/08 15:50:47	194.7	49.4	14.1
02/12/08 15:50:57	191.7	48.2	14.2
02/12/08 15:51:07	184.5	47.3	14.2
02/12/08 15:51:17	177.1	45.5	14.1
02/12/08 15:51:27	183.3	43.8	14.3
02/12/08 15:51:37	197.0	44.0	14.7
02/12/08 15:51:47	197.7	44.4	15.0
02/12/08 15:51:57	197.4	42.0	15.0
02/12/08 15:52:07	207.6	39.9	14.9

02/12/08 15:52:17	219.5	39.6	14.8
02/12/08 15:52:27	231.2	39.6	14.5
02/12/08 15:52:37	259.3	40.5	14.4
02/12/08 15:52:47	280.3	41.4	14.6
02/12/08 15:52:57	249.9	42.3	14.3
02/12/08 15:53:07	209.4	42.9	14.2
02/12/08 15:53:17	201.3	44.1	14.4
02/12/08 15:53:27	200.7	45.3	14.2
02/12/08 15:53:37	187.5	45.3	14.1
02/12/08 15:53:47	161.6	45.2	14.1
02/12/08 15:53:57	134.1	45.5	13.9
02/12/08 15:54:07	112.1	46.2	13.9
02/12/08 15:54:17	104.3	46.7	13.9
02/12/08 15:54:27	124.8	47.3	14.1
02/12/08 15:54:37	152.2	47.3	14.5
02/12/08 15:54:47	158.6	47.3	14.7
02/12/08 15:54:57	150.8	45.6	14.4
02/12/08 15:55:07	151.4	43.5	14.0
02/12/08 15:55:17	137.9	45.0	13.6
02/12/08 15:55:27	111.6	46.1	13.4
02/12/08 15:55:37	95.1	48.2	13.3
02/12/08 15:55:47	99.0	50.3	13.5
02/12/08 15:55:57	107.6	50.3	13.8
02/12/08 15:56:07	169.1	50.2	13.2
02/12/08 15:56:17	209.4	49.4	13.1
02/12/08 15:56:27	189.9	48.8	13.1
02/12/08 15:56:37	155.3	50.8	13.5
02/12/08 15:56:47	140.6	52.4	13.8
02/12/08 15:56:57	145.9	50.6	13.7
02/12/08 15:57:07	143.3	48.5	13.9
02/12/08 15:57:17	134.4	49.1	14.3
02/12/08 15:57:27	132.6	50.0	14.7
02/12/08 15:57:37	160.4	46.7	15.0
02/12/08 15:57:47	203.4	43.5	14.9
02/12/08 15:57:57	240.5	42.5	14.6
02/12/08 15:58:07	267.8	41.7	14.5
02/12/08 15:58:17	275.3	42.8	14.4
02/12/08 15:58:27	248.4	43.8	14.2
02/12/08 15:58:37	190.2	44.3	14.0
02/12/08 15:58:47	137.3	45.2	14.0
02/12/08 15:58:57	119.4	46.1	14.1
02/12/08 15:59:07	128.4	47.0	14.5
02/12/08 15:59:17	136.1	45.8	14.6
02/12/08 15:59:27	137.4	44.3	14.4
02/12/08 15:59:37	154.0	43.5	14.1
02/12/08 15:59:47	171.5	42.2	13.9
02/12/08 15:59:57	171.0	43.8	13.5
02/12/08 16:00:07	150.1	45.3	13.2
02/12/08 16:00:17	133.5	47.0	13.2
02/12/08 16:00:27	136.1	48.5	13.2
02/12/08 16:00:37	161.3	47.3	13.1
02/12/08 16:00:47	191.7	45.8	13.3
02/12/08 16:00:57	190.8	45.8	13.4
02/12/08 16:01:07	161.6	45.8	13.5
02/12/08 16:01:17	153.8	46.5	13.7
02/12/08 16:01:27	170.9	46.7	13.9
02/12/08 16:01:37	215.3	46.2	14.0
02/12/08 16:01:47	235.9	45.5	14.0

02/12/08 16:01:57	255.1	45.3	14.1
02/12/08 16:02:07	269.9	45.3	14.2
02/12/08 16:02:17	300.5	44.1	14.2
02/12/08 16:02:27	374.5	42.9	14.4
02/12/08 16:02:37	436.5	42.0	14.4
02/12/08 16:02:47	470.9	41.1	14.5
02/12/08 16:02:57	438.9	40.1	14.6
02/12/08 16:03:07	360.4	39.6	14.5
02/12/08 16:03:17	298.7	39.6	14.5
02/12/08 16:03:27	300.5	39.6	14.5
02/12/08 16:03:37	284.6	39.9	14.6
02/12/08 16:03:47	239.2	40.4	14.4
02/12/08 16:03:57	217.5	39.9	14.4
02/12/08 16:04:07	203.2	39.3	14.3
02/12/08 16:04:17	178.6	39.9	14.6
02/12/08 16:04:27	165.0	40.2	14.4
02/12/08 16:04:37	173.0	40.5	14.0
02/12/08 16:04:47	165.0	40.8	13.9
02/12/08 16:04:57	132.9	42.6	13.8
02/12/08 16:05:07	113.3	44.4	14.1
02/12/08 16:05:17	118.8	44.9	14.4
02/12/08 16:05:27	142.1	45.5	14.7
02/12/08 16:05:37	150.1	44.1	14.5
02/12/08 16:05:47	136.4	42.9	14.2
02/12/08 16:05:57	139.9	42.6	13.4
02/12/08 16:06:07	134.9	42.6	13.4
02/12/08 16:06:17	115.1	46.1	13.5
02/12/08 16:06:27	114.8	49.7	13.6
02/12/08 16:06:37	124.7	49.1	13.9
02/12/08 16:06:47	130.1	48.5	14.1
02/12/08 16:06:57	126.9	47.0	14.2
02/12/08 16:07:07	121.1	45.5	14.2
02/12/08 16:07:17	153.5	44.1	14.2
02/12/08 16:07:27	207.6	42.9	14.4
02/12/08 16:07:37	222.2	43.2	14.5
02/12/08 16:07:47	196.5	43.5	14.4
02/12/08 16:07:57	163.3	42.6	14.4
02/12/08 16:08:07	142.1	42.0	14.3
02/12/08 16:08:17	141.5	42.0	14.2
02/12/08 16:08:27	169.8	42.3	14.4
02/12/08 16:08:37	207.3	42.3	14.4
02/12/08 16:08:47	213.2	42.3	14.2
02/12/08 16:08:57	186.7	43.4	14.5
02/12/08 16:09:07	154.1	44.4	14.4
02/12/08 16:09:17	147.4	44.3	14.0
02/12/08 16:09:27	147.2	44.4	13.8
02/12/08 16:09:37	148.1	44.9	13.9
02/12/08 16:09:47	136.7	45.9	13.9
02/12/08 16:09:57	138.7	45.5	13.8
02/12/08 16:10:07	156.2	45.2	13.7
02/12/08 16:10:17	181.0	46.1	13.7
02/12/08 16:10:27	212.1	47.0	13.9
02/12/08 16:10:37	239.4	46.7	14.3
02/12/08 16:10:47	247.8	46.4	14.4
02/12/08 16:10:57	227.3	45.3	14.6
02/12/08 16:11:07	193.2	44.1	14.6
02/12/08 16:11:17	192.0	42.6	14.6
02/12/08 16:11:27	218.3	41.1	14.5

02/12/08 16:11:37	232.9	41.4	14.5
02/12/08 16:11:47	210.5	42.0	14.4
02/12/08 16:11:57	173.9	42.8	14.2
02/12/08 16:12:07	131.8	43.8	14.2
02/12/08 16:12:17	104.1	44.0	13.8
02/12/08 16:12:27	116.6	44.4	13.2
02/12/08 16:12:37	128.9	46.1	13.0
02/12/08 16:12:47	112.1	47.6	13.2
02/12/08 16:12:57	88.8	50.6	13.6
02/12/08 16:13:07	104.0	53.3	14.0
02/12/08 16:13:17	160.1	49.7	14.4
02/12/08 16:13:27	224.6	45.8	14.7
02/12/08 16:13:37	238.1	43.2	14.7
02/12/08 16:13:47	215.0	40.4	14.2
02/12/08 16:13:57	194.3	40.7	14.0
02/12/08 16:14:07	178.6	41.1	13.7
02/12/08 16:14:17	157.1	43.5	13.7
02/12/08 16:14:27	137.9	45.2	14.0
02/12/08 16:14:37	137.9	45.5	14.3
02/12/08 16:14:47	143.1	45.9	14.2
02/12/08 16:14:57	152.2	45.5	14.0
02/12/08 16:15:07	155.6	45.5	13.8
02/12/08 16:15:17	141.5	45.5	13.8
02/12/08 16:15:27	143.4	45.8	13.6
02/12/08 16:15:37	156.4	46.7	13.9
02/12/08 16:15:47	152.6	47.6	13.8
02/12/08 16:15:57	152.6	46.7	13.7
02/12/08 16:16:07	148.4	46.1	13.5
02/12/08 16:16:17	135.6	47.3	13.5
02/12/08 16:16:27	136.4	48.5	13.9
02/12/08 16:16:37	134.1	47.9	14.2
02/12/08 16:16:47	137.6	47.0	14.0
02/12/08 16:16:57	150.1	46.4	13.9
02/12/08 16:17:07	140.6	45.8	14.1
02/12/08 16:17:17	111.9	45.8	14.2
02/12/08 16:17:27	95.5	45.5	14.3
02/12/08 16:17:37	120.0	44.4	14.3
02/12/08 16:17:47	152.6	42.9	14.1
02/12/08 16:17:57	170.4	42.9	14.0
02/12/08 16:18:07	202.5	42.5	14.3
02/12/08 16:18:17	257.9	42.0	14.8
02/12/08 16:18:27	283.3	41.4	14.9
02/12/08 16:18:37	307.6	39.3	14.9
02/12/08 16:18:47	361.6	37.3	14.9
02/12/08 16:18:57	392.2	36.4	14.8
02/12/08 16:19:07	343.4	35.8	14.3
02/12/08 16:19:17	246.0	39.0	13.9
02/12/08 16:19:27	164.7	42.3	13.5
02/12/08 16:19:37	123.9	45.3	13.3
02/12/08 16:19:47	102.9	48.5	13.2
02/12/08 16:19:57	90.4	49.4	13.0
02/12/08 16:20:07	85.3	50.5	12.9
02/12/08 16:20:17	82.1	50.9	12.8
02/12/08 16:20:27	72.8	51.1	12.8
02/12/08 16:20:37	70.7	52.4	13.1
02/12/08 16:20:47	100.5	53.3	13.3
02/12/08 16:20:57	142.1	51.2	13.7
02/12/08 16:21:07	179.7	48.8	13.8

02/12/08 16:21:17	186.3	47.9	14.1
02/12/08 16:21:27	158.8	46.7	13.9
02/12/08 16:21:37	119.4	46.4	13.6
02/12/08 16:21:47	90.0	46.1	13.4
02/12/08 16:21:57	74.6	47.6	13.6
02/12/08 16:22:07	81.2	48.8	13.9
02/12/08 16:22:17	109.8	47.3	14.1
02/12/08 16:22:27	143.1	45.5	14.1
02/12/08 16:22:37	158.3	44.6	14.1
02/12/08 16:22:47	166.8	43.8	14.2
02/12/08 16:22:57	163.0	44.0	14.0
02/12/08 16:23:07	158.9	44.4	14.2
02/12/08 16:23:17	170.3	43.7	14.4
02/12/08 16:23:27	188.7	43.5	14.3
02/12/08 16:23:37	193.8	42.5	14.2
02/12/08 16:23:47	201.0	42.0	14.4
02/12/08 16:23:57	204.9	42.3	14.7
02/12/08 16:24:07	212.4	42.6	14.8
02/12/08 16:24:17	208.5	42.0	14.8
02/12/08 16:24:27	195.3	41.4	14.8
02/12/08 16:24:37	183.4	40.4	14.7
02/12/08 16:24:47	191.1	39.6	14.3
02/12/08 16:24:57	204.6	41.0	14.3
02/12/08 16:25:07	185.8	42.3	14.3
02/12/08 16:25:17	144.6	43.2	14.2
02/12/08 16:25:27	128.1	44.0	14.3
02/12/08 16:25:37	134.7	43.8	14.3
02/12/08 16:25:47	130.4	43.8	14.3
02/12/08 16:25:57	119.7	43.2	14.0
02/12/08 16:26:07	113.0	42.9	13.9
02/12/08 16:26:17	111.2	44.3	14.1
02/12/08 16:26:27	110.4	45.5	14.3
02/12/08 16:26:37	120.9	44.6	14.3
02/12/08 16:26:47	140.9	43.8	14.1
02/12/08 16:26:57	148.1	43.5	14.2
02/12/08 16:27:07	131.4	43.2	14.3
02/12/08 16:27:17	125.1	43.8	14.4
02/12/08 16:27:27	150.2	44.4	14.7
02/12/08 16:27:37	189.4	42.6	14.9
02/12/08 16:27:47	204.3	40.8	14.9
02/12/08 16:27:57	208.8	39.9	15.0
02/12/08 16:28:07	229.8	38.7	14.8
02/12/08 16:28:17	245.4	39.0	14.7
02/12/08 16:28:27	210.0	39.0	14.4
02/12/08 16:28:37	149.9	40.8	14.4
02/12/08 16:28:47	107.0	42.6	14.6
02/12/08 16:28:57	90.9	42.0	14.6
02/12/08 16:29:07	129.6	41.7	14.2
02/12/08 16:29:17	194.1	42.8	14.3
02/12/08 16:29:27	207.0	43.8	14.4
02/12/08 16:29:37	189.0	44.4	14.5
02/12/08 16:29:47	188.5	44.7	14.4
02/12/08 16:29:57	202.9	44.6	14.6
02/12/08 16:30:07	204.3	44.4	14.5
02/12/08 16:30:17	192.3	43.7	14.4
02/12/08 16:30:27	169.8	43.2	14.3
02/12/08 16:30:37	144.0	43.8	14.1
02/12/08 16:30:47	144.6	44.4	13.7

02/12/08 16:30:57	143.9	46.1	13.7
02/12/08 16:31:07	129.3	48.2	13.6
02/12/08 16:31:17	111.3	48.5	13.5
02/12/08 16:31:27	102.3	48.8	13.6
02/12/08 16:31:37	95.8	49.1	13.6
02/12/08 16:31:47	90.0	49.4	13.7
02/12/08 16:31:57	104.0	48.2	13.7
02/12/08 16:32:07	129.3	47.3	13.6
02/12/08 16:32:17	123.6	48.2	13.3
02/12/08 16:32:27	97.3	48.8	13.4
02/12/08 16:32:37	77.6	50.0	13.6
02/12/08 16:32:47	79.1	51.5	14.1
02/12/08 16:32:57	84.5	49.7	14.2
02/12/08 16:33:07	89.2	47.9	14.1
02/12/08 16:33:17	99.6	45.8	13.9
02/12/08 16:33:27	144.0	44.1	13.5
02/12/08 16:33:37	187.9	46.1	13.5
02/12/08 16:33:47	211.5	48.1	13.6
02/12/08 16:33:57	235.4	48.2	13.7
02/12/08 16:34:07	237.8	48.1	14.1
02/12/08 16:34:17	214.4	47.6	14.2
02/12/08 16:34:27	196.9	46.7	14.1
02/12/08 16:34:37	191.4	46.4	14.2
02/12/08 16:34:47	179.2	46.4	14.2
02/12/08 16:34:57	173.6	45.2	14.0
02/12/08 16:35:07	220.1	44.3	13.9
02/12/08 16:35:17	335.1	42.8	14.0
02/12/08 16:35:27	375.4	41.7	14.0
02/12/08 16:35:37	322.0	43.5	14.2
02/12/08 16:35:47	270.0	45.3	14.0
02/12/08 16:35:57	253.3	44.1	14.0
02/12/08 16:36:07	239.5	43.2	13.9
02/12/08 16:36:17	211.5	43.8	13.7
02/12/08 16:36:27	168.9	44.7	13.6
02/12/08 16:36:37	122.1	47.3	13.6
02/12/08 16:36:47	100.6	50.0	13.9
02/12/08 16:36:57	108.2	49.0	14.2
02/12/08 16:37:07	120.0	47.9	14.2
02/12/08 16:37:17	141.2	46.1	14.1
02/12/08 16:37:27	272.8	44.4	13.9
02/12/08 16:37:37	394.9	39.9	14.1
02/12/08 16:37:47	404.9	35.1	14.3
02/12/08 16:37:57	326.5	38.7	14.4
02/12/08 16:38:07	241.2	42.0	14.4
02/12/08 16:38:17	204.1	42.9	14.3
02/12/08 16:38:27	198.6	43.4	14.3
02/12/08 16:38:37	175.4	44.1	14.4
02/12/08 16:38:47	142.7	44.6	14.3
02/12/08 16:38:57	142.7	44.3	14.2
02/12/08 16:39:07	155.6	44.1	14.2
02/12/08 16:39:17	166.0	44.1	14.3
02/12/08 16:39:27	193.5	44.1	14.7
02/12/08 16:39:37	228.2	42.0	14.9
02/12/08 16:39:47	267.3	39.8	14.9
02/12/08 16:39:57	286.1	39.8	14.9
02/12/08 16:40:07	272.9	40.1	14.9
02/12/08 16:40:17	233.0	39.2	14.9
02/12/08 16:40:27	200.5	38.4	14.9

02/12/08 16:40:37	214.4	38.1	15.0
02/12/08 16:40:47	252.8	37.5	15.1
02/12/08 16:40:57	299.1	37.6	14.9
02/12/08 16:41:07	350.6	37.8	14.7
02/12/08 16:41:17	364.4	38.6	14.5
02/12/08 16:41:27	314.4	39.9	14.6
02/12/08 16:41:37	242.7	41.4	14.5
02/12/08 16:41:47	200.8	43.2	14.3
02/12/08 16:41:57	183.7	43.5	14.2
02/12/08 16:42:07	173.0	44.0	14.1
02/12/08 16:42:17	173.6	44.0	14.1
02/12/08 16:42:27	181.1	44.1	14.5
02/12/08 16:42:37	171.8	45.0	14.7
02/12/08 16:42:47	155.0	45.5	14.6
02/12/08 16:42:57	132.9	44.1	14.5
02/12/08 16:43:07	143.4	42.5	14.2
02/12/08 16:43:17	198.7	43.4	14.1
02/12/08 16:43:27	217.8	44.0	14.3
02/12/08 16:43:37	190.0	44.6	14.2
02/12/08 16:43:47	151.1	44.9	14.1
02/12/08 16:43:57	123.0	45.5	14.2
02/12/08 16:44:07	121.2	46.1	14.1
02/12/08 16:44:17	137.6	45.5	13.8
02/12/08 16:44:27	137.6	45.2	13.8
02/12/08 16:44:37	123.9	46.7	13.8
02/12/08 16:44:47	107.8	48.2	13.9
02/12/08 16:44:57	102.3	48.5	14.0
02/12/08 16:45:07	117.0	48.4	14.3
02/12/08 16:45:17	128.1	47.6	14.9
02/12/08 16:45:27	144.0	46.3	15.9
02/12/08 16:45:37	182.5	40.5	16.4
02/12/08 16:45:47	231.2	34.6	16.6
02/12/08 16:45:57	263.6	27.4	16.7
Run 1 Average >	219.5	41.4	14.5

## Victor School, NOx, CO Test Data, Run 2

Date/Time mm/dd/yy hh:mm:ss	CO ppm	NOx ppm	O2 %
02/12/08 17:11:07	192.3	39.3	14.3
02/12/08 17:11:17	201.7	40.5	14.4
02/12/08 17:11:27	238.5	41.7	14.7
02/12/08 17:11:37	271.9	39.2	15.0
02/12/08 17:11:47	290.5	37.2	14.9
02/12/08 17:11:57	319.6	36.6	14.7
02/12/08 17:12:07	318.3	35.7	14.5
02/12/08 17:12:17	284.3	35.7	14.3
02/12/08 17:12:27	275.8	35.7	14.2
02/12/08 17:12:37	295.0	37.5	14.3
02/12/08 17:12:47	280.3	39.0	14.1
02/12/08 17:12:57	249.6	39.6	14.1
02/12/08 17:13:07	247.8	40.2	14.2
02/12/08 17:13:17	260.0	42.0	14.2
02/12/08 17:13:27	258.5	43.5	14.2
02/12/08 17:13:37	253.3	42.3	13.9
02/12/08 17:13:47	259.6	41.1	13.7
02/12/08 17:13:57	231.8	43.1	13.7
02/12/08 17:14:07	190.8	45.2	13.8
02/12/08 17:14:17	168.9	46.0	13.6
02/12/08 17:14:27	167.4	46.7	13.3
02/12/08 17:14:37	198.6	47.0	12.9
02/12/08 17:14:47	203.4	47.3	13.0
02/12/08 17:14:57	166.2	49.7	12.9
02/12/08 17:15:07	134.3	52.0	13.0
02/12/08 17:15:17	111.6	51.7	13.1
02/12/08 17:15:27	103.4	51.7	13.2
02/12/08 17:15:37	115.4	51.1	13.4
02/12/08 17:15:47	128.1	50.5	13.4
02/12/08 17:15:57	127.2	49.7	13.6
02/12/08 17:16:07	126.6	49.0	13.6
02/12/08 17:16:17	139.9	49.0	13.5
02/12/08 17:16:27	158.6	49.0	13.5
02/12/08 17:16:37	166.5	49.4	13.4
02/12/08 17:16:47	143.1	49.7	13.3
02/12/08 17:16:57	117.1	50.2	13.1
02/12/08 17:17:07	100.5	50.8	13.5
02/12/08 17:17:17	108.5	51.4	13.8
02/12/08 17:17:27	143.6	52.0	13.9
02/12/08 17:17:37	185.8	49.4	13.5
02/12/08 17:17:47	199.2	47.0	13.7
02/12/08 17:17:57	175.6	48.1	13.9
02/12/08 17:18:07	146.2	49.4	14.0
02/12/08 17:18:17	133.8	47.6	14.1
02/12/08 17:18:27	128.7	45.8	13.9
02/12/08 17:18:37	118.3	46.1	13.9
02/12/08 17:18:47	123.9	46.4	14.0
02/12/08 17:18:57	127.7	47.0	14.2
02/12/08 17:19:07	131.4	47.8	14.3
02/12/08 17:19:17	136.1	47.0	13.8
02/12/08 17:19:27	154.6	46.1	13.6
02/12/08 17:19:37	154.1	48.1	13.9

02/12/08 17:19:47	138.2	49.9	13.9
02/12/08 17:19:57	136.4	48.2	13.9
02/12/08 17:20:07	145.2	46.7	14.2
02/12/08 17:20:17	158.3	46.4	14.4
02/12/08 17:20:27	172.1	45.8	14.7
02/12/08 17:20:37	183.1	44.6	14.7
02/12/08 17:20:47	171.3	43.4	14.3
02/12/08 17:20:57	137.7	44.1	13.5
02/12/08 17:21:07	118.0	44.6	12.8
02/12/08 17:21:17	115.6	48.4	12.4
02/12/08 17:21:27	108.5	52.6	12.6
02/12/08 17:21:37	92.4	54.7	12.7
02/12/08 17:21:47	87.1	56.4	12.9
02/12/08 17:21:57	97.3	55.2	13.4
02/12/08 17:22:07	106.4	54.4	13.8
02/12/08 17:22:17	117.7	52.0	13.8
02/12/08 17:22:27	133.2	49.9	14.1
02/12/08 17:22:37	151.3	49.9	14.3
02/12/08 17:22:47	168.0	49.9	14.2
02/12/08 17:22:57	186.7	48.2	14.0
02/12/08 17:23:07	189.6	46.4	13.7
02/12/08 17:23:17	168.5	47.6	13.8
02/12/08 17:23:27	147.8	48.7	14.0
02/12/08 17:23:37	173.5	47.0	14.0
02/12/08 17:23:47	236.0	45.2	14.0
02/12/08 17:23:57	279.4	45.0	13.7
02/12/08 17:24:07	289.0	44.3	13.8
02/12/08 17:24:17	260.0	44.9	13.9
02/12/08 17:24:27	209.1	45.4	13.9
02/12/08 17:24:37	160.7	45.5	13.6
02/12/08 17:24:47	127.5	45.8	13.5
02/12/08 17:24:57	113.6	47.3	13.4
02/12/08 17:25:07	109.7	48.7	13.4
02/12/08 17:25:17	136.8	47.9	13.6
02/12/08 17:25:27	189.0	47.0	13.9
02/12/08 17:25:37	222.8	44.9	13.9
02/12/08 17:25:47	222.5	43.1	14.1
02/12/08 17:25:57	224.4	42.8	14.3
02/12/08 17:26:07	232.4	42.6	14.5
02/12/08 17:26:17	233.9	41.6	14.7
02/12/08 17:26:27	259.6	40.7	14.7
02/12/08 17:26:37	315.3	40.1	14.7
02/12/08 17:26:47	372.2	39.9	14.8
02/12/08 17:26:57	394.0	39.0	14.7
02/12/08 17:27:07	396.0	38.0	14.8
02/12/08 17:27:17	381.4	39.3	14.8
02/12/08 17:27:27	330.4	39.8	14.4
02/12/08 17:27:37	266.5	39.8	14.2
02/12/08 17:27:47	225.2	39.5	14.1
02/12/08 17:27:57	189.6	41.9	14.1
02/12/08 17:28:07	165.9	44.3	14.0
02/12/08 17:28:17	156.2	44.6	14.0
02/12/08 17:28:27	165.9	45.2	14.0
02/12/08 17:28:37	185.2	46.1	14.2
02/12/08 17:28:47	193.5	47.0	14.3
02/12/08 17:28:57	180.3	46.4	14.2
02/12/08 17:29:07	149.8	45.8	14.2
02/12/08 17:29:17	120.6	45.2	13.8

02/12/08 17:29:27	128.3	44.6	13.7
02/12/08 17:29:37	161.9	45.8	13.4
02/12/08 17:29:47	177.7	47.0	13.7
02/12/08 17:29:57	171.4	48.2	13.7
02/12/08 17:30:07	163.3	49.6	13.7
02/12/08 17:30:17	143.0	49.3	13.6
02/12/08 17:30:27	119.4	49.3	13.7
02/12/08 17:30:37	109.8	49.4	13.8
02/12/08 17:30:47	121.2	49.4	14.0
02/12/08 17:30:57	137.3	48.5	14.1
02/12/08 17:31:07	152.9	47.3	14.3
02/12/08 17:31:17	159.8	46.1	14.1
02/12/08 17:31:27	173.9	44.6	14.0
02/12/08 17:31:37	174.4	45.2	13.7
02/12/08 17:31:47	161.0	45.7	13.9
02/12/08 17:31:57	148.4	47.0	14.0
02/12/08 17:32:07	145.1	48.5	14.3
02/12/08 17:32:17	138.7	47.3	14.3
02/12/08 17:32:27	123.8	46.1	14.1
02/12/08 17:32:37	111.3	45.8	13.8
02/12/08 17:32:47	116.8	45.5	13.5
02/12/08 17:32:57	130.8	47.6	13.6
02/12/08 17:33:07	148.1	49.7	13.5
02/12/08 17:33:17	143.3	50.2	13.5
02/12/08 17:33:27	118.0	51.1	13.5
02/12/08 17:33:37	87.4	50.5	13.5
02/12/08 17:33:47	73.4	50.3	13.4
02/12/08 17:33:57	152.6	49.6	13.4
02/12/08 17:34:07	231.4	49.0	13.8
02/12/08 17:34:17	247.8	49.1	14.3
02/12/08 17:34:27	231.8	49.4	14.5
02/12/08 17:34:37	233.6	47.6	14.4
02/12/08 17:34:47	226.4	45.8	14.3
02/12/08 17:34:57	210.5	45.7	14.2
02/12/08 17:35:07	183.6	46.1	13.9
02/12/08 17:35:17	151.9	46.1	13.7
02/12/08 17:35:27	131.5	46.1	13.6
02/12/08 17:35:37	122.1	47.6	13.6
02/12/08 17:35:47	115.4	48.7	13.7
02/12/08 17:35:57	115.0	47.9	13.4
02/12/08 17:36:07	150.1	47.3	13.7
02/12/08 17:36:17	203.4	46.1	14.0
02/12/08 17:36:27	237.4	45.0	13.9
02/12/08 17:36:37	236.6	46.1	14.1
02/12/08 17:36:47	200.5	47.2	14.2
02/12/08 17:36:57	157.7	46.4	14.2
02/12/08 17:37:07	138.0	45.5	14.0
02/12/08 17:37:17	128.4	46.1	13.7
02/12/08 17:37:27	115.4	46.7	13.6
02/12/08 17:37:37	108.8	48.5	13.7
02/12/08 17:37:47	122.7	50.0	13.9
02/12/08 17:37:57	155.8	49.4	13.7
02/12/08 17:38:07	209.4	48.5	13.5
02/12/08 17:38:17	227.9	49.6	13.6
02/12/08 17:38:27	210.2	50.9	13.9
02/12/08 17:38:37	193.8	49.0	14.1
02/12/08 17:38:47	180.1	47.6	14.3
02/12/08 17:38:57	165.0	46.1	13.9

02/12/08 17:39:07	162.9	44.3	13.6
02/12/08 17:39:17	164.7	47.0	13.6
02/12/08 17:39:27	143.0	49.6	13.8
02/12/08 17:39:37	121.8	49.7	14.0
02/12/08 17:39:47	124.2	49.3	14.0
02/12/08 17:39:57	161.0	47.8	14.0
02/12/08 17:40:07	204.3	46.4	14.0
02/12/08 17:40:17	223.1	45.8	14.2
02/12/08 17:40:27	207.3	44.9	14.2
02/12/08 17:40:37	194.7	43.8	13.9
02/12/08 17:40:47	173.3	42.2	13.7
02/12/08 17:40:57	152.6	45.5	13.8
02/12/08 17:41:07	135.6	49.0	13.6
02/12/08 17:41:17	117.1	48.8	14.0
02/12/08 17:41:27	112.7	48.5	14.0
02/12/08 17:41:37	140.6	47.6	13.9
02/12/08 17:41:47	191.1	46.9	13.9
02/12/08 17:41:57	209.6	46.7	13.8
02/12/08 17:42:07	185.8	46.7	13.9
02/12/08 17:42:17	156.8	47.3	13.6
02/12/08 17:42:27	136.4	47.9	13.5
02/12/08 17:42:37	104.9	48.7	13.6
02/12/08 17:42:47	85.9	49.9	13.8
02/12/08 17:42:57	82.7	49.0	13.9
02/12/08 17:43:07	96.1	47.9	13.8
02/12/08 17:43:17	117.9	47.6	13.5
02/12/08 17:43:27	124.5	47.3	13.6
02/12/08 17:43:37	106.7	48.2	13.5
02/12/08 17:43:47	85.3	48.7	13.6
02/12/08 17:43:57	83.6	48.5	13.8
02/12/08 17:44:07	100.8	48.1	13.9
02/12/08 17:44:17	139.6	47.6	14.0
02/12/08 17:44:27	168.8	47.0	14.0
02/12/08 17:44:37	163.0	47.0	14.3
02/12/08 17:44:47	167.1	47.0	14.4
02/12/08 17:44:57	193.2	45.5	14.4
02/12/08 17:45:07	202.2	44.0	14.5
02/12/08 17:45:17	194.1	44.3	14.7
02/12/08 17:45:27	206.7	44.4	14.3
02/12/08 17:45:37	210.2	43.5	13.8
02/12/08 17:45:47	177.7	42.3	13.7
02/12/08 17:45:57	150.2	44.7	13.9
02/12/08 17:46:07	167.3	47.0	13.7
02/12/08 17:46:17	188.4	46.1	13.5
02/12/08 17:46:27	154.7	45.5	13.4
02/12/08 17:46:37	126.6	47.3	13.1
02/12/08 17:46:47	124.8	49.1	13.1
02/12/08 17:46:57	107.9	50.3	13.4
02/12/08 17:47:07	96.3	51.7	13.7
02/12/08 17:47:17	113.9	51.2	13.9
02/12/08 17:47:27	138.5	50.2	14.2
02/12/08 17:47:37	149.9	48.2	14.7
02/12/08 17:47:47	168.5	45.8	14.4
02/12/08 17:47:57	203.4	43.4	14.4
02/12/08 17:48:07	201.6	40.8	14.4
02/12/08 17:48:17	167.0	41.7	14.4
02/12/08 17:48:27	131.1	42.9	14.3
02/12/08 17:48:37	137.6	44.4	14.6

02/12/08 17:48:47	180.3	46.1	14.8
02/12/08 17:48:57	186.4	44.4	14.9
02/12/08 17:49:07	167.6	42.6	14.6
02/12/08 17:49:17	193.8	41.4	14.6
02/12/08 17:49:27	220.1	40.2	14.7
02/12/08 17:49:37	201.4	41.6	15.0
02/12/08 17:49:47	189.6	43.1	15.0
02/12/08 17:49:57	234.8	42.2	15.0
02/12/08 17:50:07	284.9	41.4	15.0
02/12/08 17:50:17	302.0	41.4	15.1
02/12/08 17:50:27	271.2	41.3	15.1
02/12/08 17:50:37	215.3	39.6	14.9
02/12/08 17:50:47	166.8	37.8	14.8
02/12/08 17:50:57	135.5	38.1	14.6
02/12/08 17:51:07	146.9	38.4	14.7
02/12/08 17:51:17	168.8	40.1	14.6
02/12/08 17:51:27	171.5	42.0	14.7
02/12/08 17:51:37	186.1	41.7	14.5
02/12/08 17:51:47	197.3	41.6	14.4
02/12/08 17:51:57	177.2	42.8	14.5
02/12/08 17:52:07	181.3	44.0	14.4
02/12/08 17:52:17	196.5	44.1	14.3
02/12/08 17:52:27	181.1	43.7	14.2
02/12/08 17:52:37	148.4	44.4	14.1
02/12/08 17:52:47	149.2	45.0	14.3
02/12/08 17:52:57	180.7	45.8	14.5
02/12/08 17:53:07	199.4	46.7	14.5
02/12/08 17:53:17	178.4	45.2	14.5
02/12/08 17:53:27	136.7	43.5	14.7
02/12/08 17:53:37	119.7	43.8	14.9
02/12/08 17:53:47	131.7	44.0	15.2
02/12/08 17:53:57	153.7	42.0	15.2
02/12/08 17:54:07	191.1	39.5	15.4
02/12/08 17:54:17	220.7	37.5	15.5
02/12/08 17:54:27	223.7	35.7	15.8
02/12/08 17:54:37	243.5	35.1	15.9
02/12/08 17:54:47	319.6	34.5	15.9
02/12/08 17:54:57	495.6	33.7	15.9
02/12/08 17:55:07	605.6	32.4	15.7
02/12/08 17:55:17	518.4	32.7	15.5
02/12/08 17:55:27	381.6	33.0	15.2
02/12/08 17:55:37	303.2	34.3	15.0
02/12/08 17:55:47	235.4	35.4	14.8
02/12/08 17:55:57	174.4	37.8	14.6
02/12/08 17:56:07	151.3	40.2	14.4
02/12/08 17:56:17	165.3	42.5	14.3
02/12/08 17:56:27	159.5	45.2	13.8
02/12/08 17:56:37	120.0	46.2	13.4
02/12/08 17:56:47	83.9	47.0	13.4
02/12/08 17:56:57	71.6	48.4	13.5
02/12/08 17:57:07	99.6	49.7	13.6
02/12/08 17:57:17	159.7	47.6	13.9
02/12/08 17:57:27	230.3	45.5	14.2
02/12/08 17:57:37	228.6	45.3	14.5
02/12/08 17:57:47	169.8	45.3	14.6
02/12/08 17:57:57	148.4	43.8	14.7
02/12/08 17:58:07	163.6	42.3	14.7
02/12/08 17:58:17	181.9	42.3	14.9

02/12/08 17:58:27	192.0	42.0	15.2
02/12/08 17:58:37	206.7	40.7	15.2
02/12/08 17:58:47	261.1	39.3	15.0
02/12/08 17:58:57	294.0	37.8	14.6
02/12/08 17:59:07	261.2	36.6	14.5
02/12/08 17:59:17	192.3	39.8	14.5
02/12/08 17:59:27	138.5	43.5	14.6
02/12/08 17:59:37	141.2	42.9	14.7
02/12/08 17:59:47	185.8	42.2	14.9
02/12/08 17:59:57	230.9	39.9	14.8
02/12/08 18:00:07	285.2	37.5	14.8
02/12/08 18:00:17	300.3	38.1	14.8
02/12/08 18:00:27	305.3	39.0	14.7
02/12/08 18:00:37	307.0	39.2	14.7
02/12/08 18:00:47	305.5	39.6	14.9
02/12/08 18:00:57	376.9	38.4	15.2
02/12/08 18:01:07	434.4	37.2	15.0
02/12/08 18:01:17	424.6	38.1	14.7
02/12/08 18:01:27	352.6	38.7	14.7
02/12/08 18:01:37	273.4	40.8	14.8
02/12/08 18:01:47	228.6	42.8	14.9
02/12/08 18:01:57	210.9	42.0	15.0
02/12/08 18:02:07	206.1	41.1	15.0
02/12/08 18:02:17	248.1	39.8	14.8
02/12/08 18:02:27	315.0	38.7	14.7
02/12/08 18:02:37	297.6	39.5	14.4
02/12/08 18:02:47	259.3	40.8	14.4
02/12/08 18:02:57	252.0	41.4	14.5
02/12/08 18:03:07	240.0	41.7	14.3
02/12/08 18:03:17	227.1	41.1	14.0
02/12/08 18:03:27	191.4	40.5	14.0
02/12/08 18:03:37	178.3	42.8	14.1
02/12/08 18:03:47	191.4	45.0	14.1
02/12/08 18:03:57	256.2	44.9	14.0
02/12/08 18:04:07	307.0	44.6	14.2
02/12/08 18:04:17	264.7	45.8	14.4
02/12/08 18:04:27	242.9	46.7	14.6
02/12/08 18:04:37	254.8	46.1	14.8
02/12/08 18:04:47	261.5	45.5	14.6
02/12/08 18:04:57	252.7	43.8	14.5
02/12/08 18:05:07	231.8	42.0	14.4
02/12/08 18:05:17	251.7	42.3	14.4
02/12/08 18:05:27	271.4	42.5	14.7
02/12/08 18:05:37	251.5	43.2	14.6
02/12/08 18:05:47	223.4	43.8	14.6
02/12/08 18:05:57	177.8	43.8	14.3
02/12/08 18:06:07	154.0	43.5	14.0
02/12/08 18:06:17	199.5	43.5	13.9
02/12/08 18:06:27	243.5	43.1	14.4
02/12/08 18:06:37	237.8	44.3	14.7
02/12/08 18:06:47	218.3	45.5	14.7
02/12/08 18:06:57	234.1	43.4	14.6
02/12/08 18:07:07	254.5	41.0	14.5
02/12/08 18:07:17	227.1	42.0	14.3
02/12/08 18:07:27	206.7	42.6	13.9
02/12/08 18:07:37	184.3	42.9	13.7
02/12/08 18:07:47	157.7	43.4	13.8
02/12/08 18:07:57	144.0	45.0	13.9

02/12/08 18:08:07	144.5	46.2	14.2
02/12/08 18:08:17	159.2	45.8	14.4
02/12/08 18:08:27	256.8	45.2	14.5
02/12/08 18:08:37	361.3	41.7	14.6
02/12/08 18:08:47	354.7	37.8	14.6
02/12/08 18:08:57	320.7	40.8	14.6
02/12/08 18:09:07	263.9	43.4	14.8
02/12/08 18:09:17	205.5	43.4	14.5
02/12/08 18:09:27	189.6	43.2	14.2
02/12/08 18:09:37	191.7	43.5	14.3
02/12/08 18:09:47	179.2	44.0	14.2
02/12/08 18:09:57	175.7	43.8	14.2
02/12/08 18:10:07	179.7	43.4	14.0
02/12/08 18:10:17	176.2	44.0	13.6
02/12/08 18:10:27	182.2	45.0	13.4
02/12/08 18:10:37	176.3	47.0	13.6
02/12/08 18:10:47	163.8	49.1	13.6
02/12/08 18:10:57	155.5	48.8	13.5
02/12/08 18:11:07	134.4	48.8	13.3
02/12/08 18:11:17	113.3	49.4	13.6
02/12/08 18:11:27	95.5	50.3	13.7
02/12/08 18:11:37	121.2	50.3	14.0
02/12/08 18:11:47	212.6	50.0	14.2
02/12/08 18:11:57	281.8	47.3	14.4
02/12/08 18:12:07	328.9	44.9	14.4
Run 2 Average >	191.0	44.9	14.1

**APPENDIX C:**  
**HIGH-FIRE PM TEST DATA**

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**Method 201A Spreadsheet  
Method 201A PM<sub>10</sub> & CT40 PM<sub>2.5</sub> Test**

COMPANY	Bitter Root
FACILITY	Victor School
LOCATION	Victor, MT
SOURCE	Boiler, High Fire
DATE	Feb 13, 08

Method 201A PM10 & CT Method 40 PM2.5

Client	Bitter Root		Number of Runs 2
Facility	Victor School		
Location	Victor, MT		
Source	Boiler, High Fire		
Test date	Feb 13, 08	Feb 13, 08	
Start time	09:37	11:15	
Test run	Three	Four	

Preliminary info			
Barometric pressure [Bp]	"Hg	26.67	26.67
Stack Diameter	inch	14	14
stack exit area	sqft	1.07	1.07
Meter box ID		2	2
meter box Yi		1.003	1.003
meter box delta H@		1.76	1.76
Pitot tube coefficient Cp		0.84	0.84

Test Information			
nozzle size [nz]	inch	0.3	0.3
filter number		2445	2443
Sample points		12	12
Test duration	min	48	48
Isokinetics [i]	%	95	91
D50 cut rate		10.16	10.18
Sample volume, eq 4.3	dscf	15.36	13.78
avg delta P	"H2O	0.098	0.089
avg sqrt delta P	"H2O	0.313	0.298
201A Constant sample rate delta H	"H2O	0.45	0.47
CT40 Constant sample rate delta H	"H2O	0.41	0.42
avg meter temp [Tm]	deg F	59.6	68.4

Stack Information				AVERAGES
avg stack temp [ts]	deg F	314	302	308
avg ABS stack temp [Ts]	deg R	774	762	768
actual stack flow	acfm	1455	1366	1411
actual stack velocity [Vs]	ft/sec	22.7	21.3	22
Standard stack flow	dscfm	776	746	761
Standard stack flow	dscf/hr	46568	44749	45658
stack moisture [bws], eq 4.4	% v/v	12.27	11.57	12
measured static pressure	"H2O	0	0	0
stack static pressure [ps]	"Hg	26.67	26.67	26.67
Oxygen content	%O2	11.3	9.1	10
Carbon dioxide content	%CO2	9.7	11.9	11
Wet (Actual) Molecular Weight, Ms	lb/lb.mole	28.5	28.8	28.7
Dry Molecular Weight, Md	lb/lb.mole	30.0	30.3	30.1

Lab Information			
Impinger H2O Gain	mls	38	35
Impinger H2O volume [Vwc(STD)], eq 4.1	scf	1.79	1.65
Silica Gel H2O Gain	grams (g)	7.63	3.28
Silica Gel volume [Vsg(STD)], eq 4.2	scf	0.36	0.15
Lab Data, cyclone > than PM10 weight gain	grams (g)	NA	NA
Lab Data, cyclone > PM2.5 weight gain	g	0.0362	0.0295
Lab Data, cyclone PM2.5 weight gain	g	0.0021	0.0020
Lab Data, Filter PM2.5 weight gain	g	0.0306	0.0318
Lab data condensible PM (CPM)	g	0.0013	0.0003
Lab data MeCl Matter (MCEM)	g	0.0019	0.0013
cyclone > PM2.5 weight gain	grains (gr)	0.5587	0.4553
cyclone PM2.5 weight gain	gr	0.0324	0.0309
Filter PM2.5 weight gain	gr	0.4722	0.4907
condensible PM (CPM)	gr	0.0201	0.0046
MeCl Matter (MCEM)	gr	0.0293	0.0201

Grain loading Emissions				AVERAGES
> PM2.5 cut	gr/dscf	0.0364	0.0330	0.0347
PM 2.5 cyclone & filter	gr/dscf	0.0329	0.0379	0.0354
condensible PM (CPM)	gr/dscf	0.0013	0.0003	0.0008
MeCl Matter (MCEM-CPM))	gr/dscf	0.0019	0.0015	0.0017
EPA PM2.5 + CPM	gr/dscf	0.0361	0.0397	0.0379
Total PM	gr/dscf	0.0725	0.0727	0.0726

Mass Rate Emissions				AVERAGES
> PM2.5 cut	lbs/hr	0.242	0.211	0.2266
PM 2.5 cyclone & filter	lbs/hr	0.219	0.242	0.2303
condensible PM (CPM)	lbs/hr	0.009	0.002	0.0054
MeCl Matter (MCEM-CPM))	lbs/hr	0.013	0.009	0.0110
EPA PM2.5 + CPM	lbs/hr	0.240	0.253	0.2467
Total PM	lbs/hr	0.482	0.465	0.4734

Emission Factor				AVERAGES
lab analysis Fd @ 0% oxygen	dscf/MMBtu @ 0%	9399	9399	9399
lab analysis Fd @ stack conditions	dscf/MMBtu @ SK	20462	16647	18555
EPA PM2.5 + CPM	lbs/MMBtu	0.105	0.094	0.0999
TPM	lbs/MMBtu	0.212	0.173	0.1923
Boiler operating rate	MMBtu/hr	2.28	2.69	2.4819

**Test Run 1**    **Bison Engineering, Method 201A PM<sub>10</sub> & CT40 PM<sub>2.5</sub> Spreadsheet**

Data by jw    Checked by CWL

<b>Facility:</b> Blitter Root	<b>Location:</b> Victor, MT	<b>Date:</b> Feb 13, 08
<b>Operators:</b> jw, mtc	<b>Filter #:</b> 2445	<b>Source:</b> Boiler, High Fire
		<b>Start time:</b> 09:37
		<b>End time:</b>

**PRELIMINARY INFO.**

<b>Pm Bp</b>	26.67	( <sup>3</sup> Hg)
<b>Diam</b>	14	(inches)
<b>Length</b>		
<b>Width</b>		
<b>Rect. sqft</b>	0	
<b>Stack AREA</b>	1.07	(sqft)
<b>Meter Box</b>	1.003	
<b>Yi</b>	1.76	
<b>Delta H@</b>	2	

**PRE TEST INFO**

Assumed moisture	10.1	(%)
Assumed Meter Temp	55.0	(deg F)
Target Run Time	48.0	(min)
Total Number of Points	12	

**TRAVERSE INFO**

Pg Static, gage pressure	0.00	( <sup>3</sup> H <sub>2</sub> O)
Stack Temp, ts	245.0	(deg F)
O <sub>2</sub> Abs stack Temp, Ts	705	(deg R)
CO <sub>2</sub> Oxygen, dry	11.3	(% v/v d)
Oxygen, wet	10.1587	(% v/v w)
Carbon Dioxide, dry	9.7	(% v/v d)
Molecular weight, dry	30.004	(lb/lb.mole)
Molecular weight, wet	28.791596	(lb/lb.mole)

**201A Calculations**

us 201A stack viscosity	215.40	(micropoise)
Qs 201A Cyclone flow rate	0.596	(ft <sup>3</sup> /min)
ΔH 201A Delta H ==>	0.45	( <sup>3</sup> H <sub>2</sub> O)
<b>RANGE</b>	0.40	- 50 °F
	0.53	+ 50 °F

**CT40 Calculations**

us CT40 stack viscosity	212.38	(micropoise)
C Cunningham Corr. Factor	1.10	
D <sub>50LL</sub> Lower limit cut diameter	9.48	(micrometers)
D <sub>50T</sub> Cut diam for cyclone	10.24	(micrometers)
Qs CT40 Cyclone flow rate	0.568	(ft <sup>3</sup> /min)
Nre Reynolds number	2518	Nre < 3162 *
ΔH CT40 Delta H ==>	0.41	( <sup>3</sup> H <sub>2</sub> O)
<b>RANGE</b>	0.36	- 50 °F
	0.48	+ 50 °F

**NOZZLE SELECTION**

Nd	136 • 15 • 164 • 182 • 197 • 215 • 233 • 264 • 3 • 342 • 39
201A	
CT40	N1•125 N2•138 N3•156 N4•172 N5•188 N6•20 N7•22 N8•25
H <sub>2</sub> O Nozzle Diameter estimate	0.283
H <sub>2</sub> O delta P (min)	ERR
H <sub>2</sub> O delta P (max)	0.186
H <sub>2</sub> O Alt - delta P (min)	ERR
H <sub>2</sub> O Alt - delta P (max)	NA

**POST TEST INFO**

Impinger water	38	Silica gel	7.63 (g)
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**CALCULATED RESULTS**

Ps Stack pressure, Ps	26.67	( <sup>3</sup> Hg)
Bws % H <sub>2</sub> O in Stack	12.27	(Bws)
Mw Actual Wet Molecular Weight	28.53	(lb/lb.mole)
Vs Dry STD sample Volume	15.36	(discf)
Final Sampling Time	45.2	(min)
us Post test stack viscosity	232.72	(micropoise)
C Post test Cunningham corr. factor	1.12	
D <sub>50LL</sub> Post test lower limit cut diameter	9.33	(micrometers)
D <sub>50T</sub> Post test cut diam for cyclone	10.16	(micrometers)
Qs std Post test cyclone flow rate	0.65	(ft <sup>3</sup> /min)
I Isokinetic Avg. ( 80 < I < 120 )	95	(%)
D50 D50 Cut Rate, ( 9 < d50 < 11 )	10.2	(um)

**Revised Sept. 08/01 by CWL**

Test No	Pre traverse		Point Time	Run Time	MetrVol	Vel head		201A CT40		Stack Temp		Meter Temp		Assumed % I	Actual % I	Rolling % I	Vel. ft/sec	S T A C K	
	dP	sqrt dP				delta P	sqrt dP	delta H	Temp	In	Out	Avg	Flow acfm					Flow dscfm	
1	0.090	0.30	3.8	3.8	773.00	0.100	0.32	0.45	277	55	53	54	86.51	89	89	22.35	1433	803	
2	0.095	0.31	3.6	7.4	775.650	0.090	0.30	0.45	277	55	54	54.5	92.60	95	92	21.20	1360	762	
3	0.100	0.32	4.0	11.4	777.420	0.110	0.33	0.45	324	60	58	59	104.95	108	97	24.18	1551	817	
4	0.100	0.32	4.0	15.4	778.960	0.110	0.33	0.45	323	60	58	59	91.25	94	96	24.16	1550	817	
5	0.110	0.33	3.8	19.2	780.100	0.100	0.32	0.45	323	61	58	59.5	74.50	76	92	23.04	1478	779	
6	0.100	0.32	3.8	23.0	781.990	0.100	0.32	0.45	324	61	58	59.5	123.60	127	98	23.05	1478	779	
7	0.096	0.31	3.8	26.8	783.520	0.100	0.32	0.45	324	61	59	60	99.96	102	99	23.05	1478	779	
8	0.090	0.30	3.6	30.4	784.530	0.090	0.30	0.45	325	63	60	61.5	73.26	75	96	21.88	1404	738	
9	0.100	0.32	3.6	34.0	785.810	0.090	0.30	0.45	325	63	60	61.5	92.84	95	96	21.88	1404	738	
10	0.110	0.33	3.8	37.8	787.220	0.100	0.32	0.45	324	63	61	62	91.77	94	95	23.05	1478	779	
11	0.110	0.33	4.0	41.8	788.660	0.110	0.33	0.45	320	63	61	62	84.67	87	95	24.11	1547	819	
12	0.090	0.30	3.4	45.2	789.880	0.080	0.28	0.45	305	64	62	63	97.82	100	95	20.37	1306	705	
	avg dP	avg. [dP	sample volume		16.880	avg. dP	avg. [dP	dH	Ts	Tm	Tm	Im °F				ft/sec	acfm	dscfm	
	0.099	0.315				0.098	0.313	0.45	314.25	59.63	59.63	59.63				22.69	1456	776	
	avg sqrt dP squared	0.099						774.25	Ts °R	519.63	519.63	519.63							



**APPENDIX D:**  
**HIGH-FIRE NO<sub>x</sub> AND CO TEST DATA**

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**Victor High Fire NOx CO test data**

		<b>Run 3</b>	<b>Run 4</b>	<b>Avg.</b>
<b>Stack Flow</b>	<b>dscfh</b>	46568	44749	<b>45658</b>
<b>Heat input</b>	<b>MMBtu/hr</b>	2.28	2.69	<b>2.5</b>
<b>NOx source concentration</b>	<b>ppmvd</b>	56.4	61.1	<b>58.8</b>
<b>NOx concentration, M19 conversion</b>	<b>lbs/dscf</b>	6.712E-06	7.271E-06	<b>6.991E-06</b>
<b>NOx mass rate</b>	<b>lbs/hr</b>	0.313	0.325	<b>0.319</b>
<b>NOx emission factor</b>	<b>lbs/MMBtu</b>	0.137	0.121	<b>0.129</b>
<b>CO source concentration</b>	<b>ppmvd</b>	100.6	210.0	<b>155.3</b>
<b>CO concentration, M19 conversion</b>	<b>lbs/dscf</b>	7.311E-06	1.526E-05	<b>1.129E-05</b>
<b>CO mass rate</b>	<b>lbs/hr</b>	0.340	0.683	<b>0.512</b>
<b>NOx emission factor</b>	<b>lbs/MMBtu</b>	0.150	0.254	<b>0.202</b>

### Victor School, NOx, CO Test Data, Run 3

Date/Time mm/dd/yy hh:mm:ss	CO ppm	NOx ppm	O2 %
02/13/08 09:37:44	131.3	55.0	11.5
02/13/08 09:37:54	155.1	55.0	11.9
02/13/08 09:38:04	155.7	54.7	12.2
02/13/08 09:38:14	151.2	54.7	11.9
02/13/08 09:38:24	138.3	54.4	11.7
02/13/08 09:38:34	133.7	54.2	11.7
02/13/08 09:38:44	123.2	54.7	11.3
02/13/08 09:38:54	116.7	55.0	11.0
02/13/08 09:39:04	112.9	56.4	10.7
02/13/08 09:39:14	116.1	57.6	10.3
02/13/08 09:39:24	143.8	57.6	10.1
02/13/08 09:39:34	156.7	57.6	10.0
02/13/08 09:39:44	161.2	57.3	9.9
02/13/08 09:39:54	157.6	57.3	9.9
02/13/08 09:40:04	163.5	56.8	10.1
02/13/08 09:40:14	165.9	56.4	10.2
02/13/08 09:40:24	169.1	55.6	10.5
02/13/08 09:40:34	146.2	54.7	10.4
02/13/08 09:40:44	136.7	57.3	10.0
02/13/08 09:40:54	146.8	60.1	9.8
02/13/08 09:41:04	146.5	60.4	10.4
02/13/08 09:41:14	131.1	60.7	11.4
02/13/08 09:41:24	110.6	60.4	11.9
02/13/08 09:41:34	102.6	60.2	11.8
02/13/08 09:41:44	104.6	58.2	12.0
02/13/08 09:41:54	102.8	56.8	12.4
02/13/08 09:42:04	105.4	55.6	13.0
02/13/08 09:42:14	110.6	54.5	12.9
02/13/08 09:42:24	113.5	53.3	12.3
02/13/08 09:42:34	114.7	52.3	12.0
02/13/08 09:42:44	120.2	53.5	11.8
02/13/08 09:42:54	119.1	55.0	11.9
02/13/08 09:43:04	116.2	54.9	12.0
02/13/08 09:43:14	115.3	55.0	11.9
02/13/08 09:43:24	114.8	55.0	12.0
02/13/08 09:43:34	120.5	55.2	11.8
02/13/08 09:43:44	137.6	55.0	11.7
02/13/08 09:43:54	147.1	54.7	11.4
02/13/08 09:44:04	139.6	55.2	11.7
02/13/08 09:44:14	120.5	55.9	11.8
02/13/08 09:44:24	124.1	55.9	11.4
02/13/08 09:44:34	137.0	56.2	11.8
02/13/08 09:44:44	140.1	56.2	11.7
02/13/08 09:44:54	132.3	56.4	11.1
02/13/08 09:45:04	125.6	56.7	11.0
02/13/08 09:45:14	128.0	57.0	11.2
02/13/08 09:45:24	133.7	56.2	10.9
02/13/08 09:45:34	133.7	55.3	10.5
02/13/08 09:45:44	129.8	57.6	10.7
02/13/08 09:45:54	126.5	60.1	11.1
02/13/08 09:46:04	115.6	60.1	11.2
02/13/08 09:46:14	108.5	59.8	10.9

02/13/08 09:46:24	118.1	59.2	11.0
02/13/08 09:46:34	120.2	58.8	11.1
02/13/08 09:46:44	119.7	59.1	10.8
02/13/08 09:46:54	105.2	59.8	10.5
02/13/08 09:47:04	122.3	60.5	10.1
02/13/08 09:47:14	138.5	61.1	9.9
02/13/08 09:47:24	141.5	62.2	9.9
02/13/08 09:47:34	149.8	63.5	10.0
02/13/08 09:47:44	143.3	64.0	10.6
02/13/08 09:47:54	123.2	64.3	11.2
02/13/08 09:48:04	103.5	62.9	10.7
02/13/08 09:48:14	87.3	61.7	10.4
02/13/08 09:48:24	78.1	62.2	10.9
02/13/08 09:48:34	74.6	62.8	11.1
02/13/08 09:48:44	75.2	61.3	10.7
02/13/08 09:48:54	84.2	59.8	9.7
02/13/08 09:49:04	110.3	60.7	9.8
02/13/08 09:49:14	114.4	61.6	10.3
02/13/08 09:49:24	108.4	62.5	10.5
02/13/08 09:49:34	95.4	63.4	10.5
02/13/08 09:49:44	89.4	62.5	10.3
02/13/08 09:49:54	96.9	61.6	10.1
02/13/08 09:50:04	121.8	62.2	10.5
02/13/08 09:50:14	119.9	62.8	11.4
02/13/08 09:50:24	102.8	60.7	11.3
02/13/08 09:50:34	92.1	58.3	11.2
02/13/08 09:50:44	96.0	58.2	10.7
02/13/08 09:50:54	105.4	58.3	10.4
02/13/08 09:51:04	101.1	59.8	10.7
02/13/08 09:51:14	96.3	61.0	10.9
02/13/08 09:51:24	93.6	60.1	11.2
02/13/08 09:51:34	89.4	59.1	11.2
02/13/08 09:51:44	87.1	58.2	11.7
02/13/08 09:51:54	92.1	57.3	11.3
02/13/08 09:52:04	98.3	57.3	11.6
02/13/08 09:52:14	98.4	57.4	11.8
02/13/08 09:52:24	98.7	56.8	12.3
02/13/08 09:52:34	102.2	55.9	12.5
02/13/08 09:52:44	103.1	54.1	11.7
02/13/08 09:52:54	111.2	52.3	11.0
02/13/08 09:53:04	112.9	54.7	10.8
02/13/08 09:53:14	110.6	57.4	10.9
02/13/08 09:53:24	104.6	58.2	11.1
02/13/08 09:53:34	106.3	58.8	10.7
02/13/08 09:53:44	115.0	59.4	10.9
02/13/08 09:53:54	114.8	60.1	10.7
02/13/08 09:54:04	104.6	58.8	10.8
02/13/08 09:54:14	95.0	57.9	11.1
02/13/08 09:54:24	92.1	57.6	10.7
02/13/08 09:54:34	90.6	57.7	10.8
02/13/08 09:54:44	87.7	58.5	11.3
02/13/08 09:54:54	82.6	59.9	11.6
02/13/08 09:55:04	88.8	57.9	11.7
02/13/08 09:55:14	91.2	55.9	11.7
02/13/08 09:55:24	88.5	54.9	11.6
02/13/08 09:55:34	89.4	54.2	11.2
02/13/08 09:55:44	86.8	54.8	11.0
02/13/08 09:55:54	83.3	55.3	10.9

02/13/08 09:56:04	72.2	55.6	10.7
02/13/08 09:56:14	64.8	56.1	11.1
02/13/08 09:56:24	65.4	56.4	12.2
02/13/08 09:56:34	73.1	56.4	12.5
02/13/08 09:56:44	75.8	53.3	12.1
02/13/08 09:56:54	85.0	49.7	11.9
02/13/08 09:57:04	86.5	50.5	11.2
02/13/08 09:57:14	85.0	51.2	11.4
02/13/08 09:57:24	75.5	51.4	11.6
02/13/08 09:57:34	77.0	52.0	11.3
02/13/08 09:57:44	82.7	52.3	11.3
02/13/08 09:57:54	85.3	52.7	11.2
02/13/08 09:58:04	88.2	53.5	11.7
02/13/08 09:58:14	81.5	54.7	12.3
02/13/08 09:58:24	78.2	53.2	12.4
02/13/08 09:58:34	77.3	51.7	12.3
02/13/08 09:58:44	82.0	51.4	12.3
02/13/08 09:58:54	92.7	51.5	12.5
02/13/08 09:59:04	96.9	51.2	12.9
02/13/08 09:59:14	94.5	50.8	12.9
02/13/08 09:59:24	89.1	50.0	13.2
02/13/08 09:59:34	92.1	49.0	13.0
02/13/08 09:59:44	103.4	49.1	12.8
02/13/08 09:59:54	108.8	49.4	12.6
02/13/08 10:00:04	102.2	50.3	12.3
02/13/08 10:00:14	97.2	51.2	12.4
02/13/08 10:00:24	98.1	52.0	12.5
02/13/08 10:00:34	104.3	52.7	12.6
02/13/08 10:00:44	113.2	52.0	12.6
02/13/08 10:00:54	128.9	51.4	11.9
02/13/08 10:01:04	126.8	52.7	11.7
02/13/08 10:01:14	115.0	54.2	11.7
02/13/08 10:01:24	111.8	55.0	11.7
02/13/08 10:01:34	113.0	55.8	11.9
02/13/08 10:01:44	110.9	55.6	12.0
02/13/08 10:01:54	104.8	55.0	11.9
02/13/08 10:02:04	101.1	55.0	12.1
02/13/08 10:02:14	100.5	55.0	12.2
02/13/08 10:02:24	96.9	54.4	11.3
02/13/08 10:02:34	105.8	54.2	11.1
02/13/08 10:02:44	101.7	55.0	10.9
02/13/08 10:02:54	97.8	55.9	11.0
02/13/08 10:03:04	101.6	57.6	11.0
02/13/08 10:03:14	98.9	59.1	11.1
02/13/08 10:03:24	96.6	59.9	11.3
02/13/08 10:03:34	96.6	60.2	11.2
02/13/08 10:03:44	96.0	59.1	11.0
02/13/08 10:03:54	92.7	58.3	11.2
02/13/08 10:04:04	87.4	58.8	11.6
02/13/08 10:04:14	86.2	59.1	11.4
02/13/08 10:04:24	81.8	58.5	11.4
02/13/08 10:04:34	77.8	57.7	11.2
02/13/08 10:04:44	76.7	57.4	11.0
02/13/08 10:04:54	79.9	57.1	10.8
02/13/08 10:05:04	83.5	58.3	10.5
02/13/08 10:05:14	79.1	59.4	10.0
02/13/08 10:05:24	76.0	60.4	10.3
02/13/08 10:05:34	72.5	61.7	10.2

02/13/08 10:05:44	71.9	62.0	10.4
02/13/08 10:05:54	71.6	61.9	11.2
02/13/08 10:06:04	76.4	60.5	12.0
02/13/08 10:06:14	89.4	58.8	12.1
02/13/08 10:06:24	102.0	56.4	12.0
02/13/08 10:06:34	97.8	54.1	11.6
02/13/08 10:06:44	91.2	53.9	11.7
02/13/08 10:06:54	91.5	53.5	11.8
02/13/08 10:07:04	90.0	53.6	11.9
02/13/08 10:07:14	83.3	53.9	11.7
02/13/08 10:07:24	78.8	54.1	11.3
02/13/08 10:07:34	82.4	54.5	11.2
02/13/08 10:07:44	92.6	55.5	11.3
02/13/08 10:07:54	101.1	56.8	11.0
02/13/08 10:08:04	101.4	57.0	10.5
02/13/08 10:08:14	102.5	57.4	10.5
02/13/08 10:08:24	101.9	58.6	10.9
02/13/08 10:08:34	103.2	59.8	11.0
02/13/08 10:08:44	102.0	58.5	10.8
02/13/08 10:08:54	100.5	57.4	10.3
02/13/08 10:09:04	102.2	58.9	10.1
02/13/08 10:09:14	98.4	60.2	10.4
02/13/08 10:09:24	90.6	60.5	10.6
02/13/08 10:09:34	94.8	61.0	11.0
02/13/08 10:09:44	90.9	60.5	11.3
02/13/08 10:09:54	96.7	59.9	11.0
02/13/08 10:10:04	104.0	59.2	11.1
02/13/08 10:10:14	114.2	58.2	11.2
02/13/08 10:10:24	110.9	58.3	11.1
02/13/08 10:10:34	108.8	57.9	11.3
02/13/08 10:10:44	115.6	57.3	11.4
02/13/08 10:10:54	116.0	56.8	11.7
02/13/08 10:11:04	111.2	56.1	11.7
02/13/08 10:11:14	103.1	55.6	11.5
02/13/08 10:11:24	96.0	55.2	11.2
02/13/08 10:11:34	100.1	54.8	11.3
02/13/08 10:11:44	101.7	55.6	11.4
02/13/08 10:11:54	93.5	56.4	10.9
02/13/08 10:12:04	83.3	56.5	10.7
02/13/08 10:12:14	78.2	56.8	10.9
02/13/08 10:12:24	77.0	57.7	10.8
02/13/08 10:12:34	75.5	58.8	11.3
02/13/08 10:12:44	75.5	57.4	11.2
02/13/08 10:12:54	77.9	55.9	11.3
02/13/08 10:13:04	80.5	55.3	11.3
02/13/08 10:13:14	80.6	54.5	11.2
02/13/08 10:13:24	81.8	55.0	11.5
02/13/08 10:13:34	83.5	55.6	11.7
02/13/08 10:13:44	83.3	54.8	11.4
02/13/08 10:13:54	83.3	53.6	10.8
02/13/08 10:14:04	85.6	54.1	10.7
02/13/08 10:14:14	85.6	54.8	11.3
02/13/08 10:14:24	91.5	54.8	11.5
02/13/08 10:14:34	94.4	55.0	11.4
02/13/08 10:14:44	91.7	54.5	11.4
02/13/08 10:14:54	88.5	54.1	11.7
02/13/08 10:15:04	81.8	53.8	12.0
02/13/08 10:15:14	81.8	53.9	11.4

02/13/08 10:15:24	84.1	53.9	11.5
02/13/08 10:15:34	80.6	54.2	11.4
02/13/08 10:15:44	81.2	54.1	11.2
02/13/08 10:15:54	81.5	54.2	11.3
02/13/08 10:16:04	83.5	54.5	10.6
02/13/08 10:16:14	88.8	54.5	10.4
02/13/08 10:16:24	100.8	56.4	10.4
02/13/08 10:16:34	108.2	58.2	10.7
02/13/08 10:16:44	106.4	58.2	10.9
02/13/08 10:16:54	99.8	58.3	11.4
02/13/08 10:17:04	96.0	56.8	11.5
02/13/08 10:17:14	99.6	55.6	11.3
02/13/08 10:17:24	99.6	55.3	11.1
02/13/08 10:17:34	98.4	55.0	11.3
02/13/08 10:17:44	97.6	55.6	11.1
02/13/08 10:17:54	99.0	56.2	11.4
02/13/08 10:18:04	102.5	55.9	11.6
02/13/08 10:18:14	98.1	55.6	11.4
02/13/08 10:18:24	93.3	55.2	11.0
02/13/08 10:18:34	88.8	55.0	10.7
02/13/08 10:18:44	93.0	56.2	10.8
02/13/08 10:18:54	88.5	57.7	10.8
02/13/08 10:19:04	81.5	57.7	10.8
02/13/08 10:19:14	83.8	57.7	10.1
02/13/08 10:19:24	87.6	59.2	10.1
02/13/08 10:19:34	83.3	60.8	10.7
02/13/08 10:19:44	79.7	59.5	11.1
02/13/08 10:19:54	77.9	58.3	11.8
02/13/08 10:20:04	76.1	57.0	11.9
02/13/08 10:20:14	73.4	55.6	12.1
02/13/08 10:20:24	68.9	53.9	12.5
02/13/08 10:20:34	74.0	52.0	12.0
02/13/08 10:20:44	78.5	51.8	11.4
02/13/08 10:20:54	80.3	51.5	11.0
02/13/08 10:21:04	79.1	53.3	10.8
02/13/08 10:21:14	73.7	55.0	10.9
02/13/08 10:21:24	66.0	53.3	10.9
02/13/08 10:21:34	62.7	51.5	11.4
02/13/08 10:21:44	74.6	52.4	11.0
02/13/08 10:21:54	85.0	53.2	11.3
02/13/08 10:22:04	86.8	54.1	11.5
02/13/08 10:22:14	86.8	54.7	11.9
02/13/08 10:22:24	82.1	53.6	11.5
02/13/08 10:22:34	86.7	52.7	12.1
02/13/08 10:22:44	96.0	52.4	12.5
02/13/08 10:22:54	101.6	52.1	12.0
02/13/08 10:23:04	102.8	51.7	11.5
02/13/08 10:23:14	101.1	51.4	11.0
02/13/08 10:23:24	93.0	53.5	10.8
02/13/08 10:23:34	92.1	55.6	11.3
02/13/08 10:23:44	86.8	56.2	11.8
02/13/08 10:23:54	82.4	56.8	11.9
02/13/08 10:24:04	84.1	55.3	12.0
Run 3 Average >	100.6	56.4	11.3

## Victor School, NOx, CO Test Data, Run 4

Date/Time mm/dd/yy hh:mm:ss	CO ppm	NOx ppm	O2 %
02/13/08 11:15:14	137.3	44.7	14.1
02/13/08 11:15:24	125.7	44.1	14.1
02/13/08 11:15:34	122.1	43.8	13.4
02/13/08 11:15:44	154.4	44.9	13.2
02/13/08 11:15:54	162.4	46.4	12.7
02/13/08 11:16:04	159.4	47.0	12.1
02/13/08 11:16:14	140.0	47.6	11.8
02/13/08 11:16:24	125.0	48.8	11.8
02/13/08 11:16:34	118.8	50.0	12.1
02/13/08 11:16:44	125.6	49.7	12.3
02/13/08 11:16:54	145.2	49.4	12.0
02/13/08 11:17:04	150.2	50.0	11.8
02/13/08 11:17:14	136.1	50.3	11.6
02/13/08 11:17:24	120.6	50.8	10.9
02/13/08 11:17:34	118.0	51.4	11.2
02/13/08 11:17:44	109.4	52.4	11.4
02/13/08 11:17:54	99.6	53.3	11.4
02/13/08 11:18:04	87.7	53.0	11.1
02/13/08 11:18:14	86.8	52.4	10.8
02/13/08 11:18:24	95.7	53.6	10.9
02/13/08 11:18:34	103.7	54.7	10.8
02/13/08 11:18:44	112.4	54.5	11.2
02/13/08 11:18:54	104.3	54.2	11.6
02/13/08 11:19:04	95.8	53.2	11.4
02/13/08 11:19:14	88.9	52.7	11.5
02/13/08 11:19:24	89.8	52.3	11.4
02/13/08 11:19:34	110.0	52.0	10.8
02/13/08 11:19:44	115.1	53.3	10.9
02/13/08 11:19:54	109.1	54.8	11.3
02/13/08 11:20:04	95.8	53.9	11.2
02/13/08 11:20:14	86.2	53.3	11.4
02/13/08 11:20:24	95.4	52.7	11.7
02/13/08 11:20:34	106.7	51.8	11.7
02/13/08 11:20:44	111.3	51.1	10.9
02/13/08 11:20:54	104.6	50.9	10.5
02/13/08 11:21:04	96.6	53.0	10.8
02/13/08 11:21:14	95.4	55.0	10.9
02/13/08 11:21:24	92.7	54.2	10.6
02/13/08 11:21:34	93.6	53.0	10.2
02/13/08 11:21:44	97.6	53.6	9.9
02/13/08 11:21:54	98.4	54.2	10.4
02/13/08 11:22:04	101.7	54.5	9.8
02/13/08 11:22:14	113.6	55.1	9.8
02/13/08 11:22:24	122.4	57.4	10.7
02/13/08 11:22:34	118.9	59.5	11.4
02/13/08 11:22:44	108.2	56.5	11.9
02/13/08 11:22:54	103.5	53.5	11.6
02/13/08 11:23:04	100.8	53.6	10.8
02/13/08 11:23:14	88.8	53.6	9.7
02/13/08 11:23:24	99.0	58.0	8.5
02/13/08 11:23:34	161.0	62.8	7.1
02/13/08 11:23:44	305.0	62.9	6.1
02/13/08 11:23:54	448.6	62.8	6.4

02/13/08 11:24:04	443.9	62.2	8.0
02/13/08 11:24:14	324.6	61.6	9.1
02/13/08 11:24:24	192.0	63.8	10.0
02/13/08 11:24:34	109.4	65.5	10.5
02/13/08 11:24:44	75.8	64.0	10.5
02/13/08 11:24:54	61.5	62.2	10.4
02/13/08 11:25:04	53.8	62.6	10.0
02/13/08 11:25:14	54.6	62.9	9.8
02/13/08 11:25:24	55.6	62.8	10.7
02/13/08 11:25:34	54.6	62.5	11.7
02/13/08 11:25:44	50.5	60.5	12.1
02/13/08 11:25:54	48.1	58.0	11.9
02/13/08 11:26:04	47.1	57.9	11.6
02/13/08 11:26:14	50.2	58.0	11.2
02/13/08 11:26:24	49.6	58.8	11.1
02/13/08 11:26:34	46.6	59.9	10.8
02/13/08 11:26:44	47.5	59.5	10.3
02/13/08 11:26:54	50.2	58.8	9.8
02/13/08 11:27:04	55.3	61.6	9.2
02/13/08 11:27:14	62.7	64.3	8.9
02/13/08 11:27:24	76.5	65.2	8.8
02/13/08 11:27:34	109.8	66.1	8.9
02/13/08 11:27:44	119.1	65.2	8.8
02/13/08 11:27:54	146.3	64.6	8.8
02/13/08 11:28:04	144.8	64.3	9.4
02/13/08 11:28:14	123.0	63.8	9.4
02/13/08 11:28:24	99.9	61.4	9.0
02/13/08 11:28:34	90.9	59.2	9.2
02/13/08 11:28:44	88.8	60.8	9.6
02/13/08 11:28:54	86.5	62.3	9.7
02/13/08 11:29:04	92.4	61.4	9.9
02/13/08 11:29:14	151.6	60.2	8.6
02/13/08 11:29:24	196.2	60.2	8.4
02/13/08 11:29:34	192.0	60.2	8.6
02/13/08 11:29:44	166.5	61.4	8.9
02/13/08 11:29:54	133.8	62.6	9.4
02/13/08 11:30:04	107.0	61.9	9.9
02/13/08 11:30:14	88.0	61.4	10.1
02/13/08 11:30:24	74.6	60.8	10.6
02/13/08 11:30:34	60.4	60.2	10.9
02/13/08 11:30:44	50.5	59.5	10.6
02/13/08 11:30:54	47.8	58.6	10.0
02/13/08 11:31:04	80.9	59.2	9.1
02/13/08 11:31:14	99.6	59.9	9.4
02/13/08 11:31:24	93.6	61.1	9.5
02/13/08 11:31:34	85.1	62.3	9.2
02/13/08 11:31:44	88.0	61.7	9.0
02/13/08 11:31:54	140.2	61.4	8.3
02/13/08 11:32:04	192.0	62.3	8.0
02/13/08 11:32:14	215.1	63.2	8.1
02/13/08 11:32:24	203.7	61.7	8.1
02/13/08 11:32:34	189.3	60.2	8.3
02/13/08 11:32:44	176.6	62.6	8.8
02/13/08 11:32:54	154.3	65.2	9.1
02/13/08 11:33:04	147.5	64.6	8.6
02/13/08 11:33:14	170.0	64.0	8.2
02/13/08 11:33:24	214.1	64.3	8.4
02/13/08 11:33:34	223.8	64.7	9.0

02/13/08 11:33:44	194.4	63.7	8.8
02/13/08 11:33:54	171.0	62.9	8.2
02/13/08 11:34:04	167.7	63.8	7.9
02/13/08 11:34:14	242.6	64.6	7.4
02/13/08 11:34:24	317.0	64.3	8.0
02/13/08 11:34:34	353.8	64.4	8.1
02/13/08 11:34:44	348.4	63.5	8.1
02/13/08 11:34:54	364.3	62.6	7.7
02/13/08 11:35:04	358.0	63.4	8.2
02/13/08 11:35:14	298.8	64.4	8.9
02/13/08 11:35:24	236.9	64.4	8.3
02/13/08 11:35:34	226.8	64.3	8.0
02/13/08 11:35:44	233.6	63.7	8.0
02/13/08 11:35:54	264.5	63.4	7.8
02/13/08 11:36:04	345.5	62.6	7.5
02/13/08 11:36:14	453.4	62.0	7.6
02/13/08 11:36:24	496.9	62.3	7.3
02/13/08 11:36:34	496.3	62.6	7.7
02/13/08 11:36:44	438.6	63.7	7.8
02/13/08 11:36:54	386.3	64.6	7.6
02/13/08 11:37:04	388.4	64.4	7.7
02/13/08 11:37:14	403.3	63.7	7.5
02/13/08 11:37:24	475.2	62.8	7.4
02/13/08 11:37:34	539.0	61.7	7.5
02/13/08 11:37:44	582.7	61.4	7.5
02/13/08 11:37:54	588.0	61.3	7.8
02/13/08 11:38:04	518.1	61.4	8.5
02/13/08 11:38:14	413.0	61.6	8.8
02/13/08 11:38:24	321.4	60.8	8.4
02/13/08 11:38:34	283.3	59.4	8.6
02/13/08 11:38:44	249.6	60.5	9.0
02/13/08 11:38:54	211.7	61.3	9.1
02/13/08 11:39:04	163.6	61.4	9.0
02/13/08 11:39:14	133.8	61.7	9.0
02/13/08 11:39:24	140.6	62.0	8.5
02/13/08 11:39:34	236.9	62.6	8.1
02/13/08 11:39:44	294.9	62.6	8.8
02/13/08 11:39:54	262.7	62.6	8.7
02/13/08 11:40:04	322.2	62.9	7.2
02/13/08 11:40:14	635.6	63.4	7.0
02/13/08 11:40:24	863.1	62.3	7.4
02/13/08 11:40:34	843.0	60.8	7.7
02/13/08 11:40:44	803.3	61.1	6.8
02/13/08 11:40:54	977.7	61.4	6.6
02/13/08 11:41:04	1068.9	59.2	6.8
02/13/08 11:41:14	1075.3	57.1	6.5
02/13/08 11:41:24	1052.0	56.5	6.5
02/13/08 11:41:34	1077.1	55.7	6.4
02/13/08 11:41:44	1017.2	57.3	7.0
02/13/08 11:41:54	798.9	58.9	7.8
02/13/08 11:42:04	575.7	62.0	7.7
02/13/08 11:42:14	450.0	64.9	8.0
02/13/08 11:42:24	374.2	64.4	8.1
02/13/08 11:42:34	375.7	64.1	7.7
02/13/08 11:42:44	432.1	63.4	7.9
02/13/08 11:42:54	406.4	62.9	9.3
02/13/08 11:43:04	298.8	62.3	9.4
02/13/08 11:43:14	198.6	61.7	8.9

02/13/08 11:43:24	174.8	60.8	8.9
02/13/08 11:43:34	227.3	59.9	8.3
02/13/08 11:43:44	305.8	59.5	7.8
02/13/08 11:43:54	485.8	58.9	6.8
02/13/08 11:44:04	971.1	59.2	6.1
02/13/08 11:44:14	1158.8	59.5	6.0
02/13/08 11:44:24	1158.8	51.5	5.2
02/13/08 11:44:34	1158.8	43.4	4.9
02/13/08 11:44:44	1158.8	47.9	5.4
02/13/08 11:44:54	1158.8	52.4	6.0
02/13/08 11:45:04	1158.9	58.0	6.7
02/13/08 11:45:14	1159.0	63.5	7.4
02/13/08 11:45:24	920.3	64.4	8.4
02/13/08 11:45:34	547.6	65.3	8.9
02/13/08 11:45:44	391.4	64.4	7.9
02/13/08 11:45:54	407.0	63.4	7.5
02/13/08 11:46:04	459.1	62.9	7.6
02/13/08 11:46:14	471.8	62.6	7.3
02/13/08 11:46:24	493.3	61.7	6.8
02/13/08 11:46:34	620.3	60.8	6.6
02/13/08 11:46:44	730.2	56.2	6.8
02/13/08 11:46:54	679.7	51.5	7.7
02/13/08 11:47:04	494.3	56.5	8.4
02/13/08 11:47:14	291.2	62.0	8.7
02/13/08 11:47:24	167.1	64.1	8.6
02/13/08 11:47:34	123.6	65.9	9.1
02/13/08 11:47:44	102.0	64.6	9.3
02/13/08 11:47:54	78.5	63.5	9.5
02/13/08 11:48:04	61.5	63.5	9.1
02/13/08 11:48:14	74.9	63.8	8.3
02/13/08 11:48:24	117.6	64.7	8.4
02/13/08 11:48:34	122.7	65.2	8.9
02/13/08 11:48:44	107.3	65.2	8.3
02/13/08 11:48:54	124.8	65.3	8.2
02/13/08 11:49:04	140.3	65.5	8.6
02/13/08 11:49:14	134.1	66.1	8.6
02/13/08 11:49:24	109.5	66.8	8.6
02/13/08 11:49:34	91.2	67.3	8.7
02/13/08 11:49:44	83.6	67.2	8.8
02/13/08 11:49:54	75.8	67.3	9.1
02/13/08 11:50:04	68.1	66.7	9.1
02/13/08 11:50:14	88.0	65.9	8.7
02/13/08 11:50:24	126.3	66.1	8.0
02/13/08 11:50:34	174.1	66.1	7.2
02/13/08 11:50:44	283.4	64.9	6.5
02/13/08 11:50:54	381.6	63.4	7.1
02/13/08 11:51:04	361.6	62.6	8.2
02/13/08 11:51:14	295.9	61.7	7.9
02/13/08 11:51:24	244.7	62.6	7.5
02/13/08 11:51:34	239.8	63.7	7.3
02/13/08 11:51:44	265.6	66.4	7.5
02/13/08 11:51:54	253.0	69.4	7.6
02/13/08 11:52:04	216.3	70.6	7.7
02/13/08 11:52:14	174.8	71.4	7.9
02/13/08 11:52:24	139.7	71.1	8.1
02/13/08 11:52:34	137.3	70.9	7.7
02/13/08 11:52:44	182.2	69.6	7.7
02/13/08 11:52:54	204.3	68.4	7.6

02/13/08 11:53:04	227.4	68.2	7.7
02/13/08 11:53:14	206.1	68.2	8.5
02/13/08 11:53:24	165.0	67.6	8.9
02/13/08 11:53:34	125.9	67.1	8.6
02/13/08 11:53:44	102.9	66.8	8.5
02/13/08 11:53:54	94.2	66.1	8.7
02/13/08 11:54:04	83.9	66.4	9.1
02/13/08 11:54:14	69.9	66.4	9.2
02/13/08 11:54:24	67.2	65.8	9.3
02/13/08 11:54:34	72.0	65.2	9.0
02/13/08 11:54:44	83.3	65.0	9.2
02/13/08 11:54:54	80.0	65.0	9.3
02/13/08 11:55:04	74.0	64.4	9.1
02/13/08 11:55:14	68.7	64.1	9.5
02/13/08 11:55:24	63.0	63.4	9.9
02/13/08 11:55:34	53.2	62.9	9.7
02/13/08 11:55:44	48.6	61.7	9.0
02/13/08 11:55:54	60.3	60.8	8.4
02/13/08 11:56:04	102.0	62.6	7.6
02/13/08 11:56:14	181.0	64.1	7.8
02/13/08 11:56:24	216.5	63.8	7.9
02/13/08 11:56:34	220.4	63.5	8.2
02/13/08 11:56:44	173.9	65.8	8.2
02/13/08 11:56:54	139.7	67.9	8.0
02/13/08 11:57:04	139.0	67.6	7.7
02/13/08 11:57:14	200.5	67.3	7.5
02/13/08 11:57:24	282.1	63.7	7.7
02/13/08 11:57:34	294.7	60.5	8.8
02/13/08 11:57:44	225.0	62.6	9.5
02/13/08 11:57:54	134.9	64.9	9.4
02/13/08 11:58:04	92.1	64.9	8.6
02/13/08 11:58:14	87.7	65.2	8.3
02/13/08 11:58:24	108.2	65.3	8.3
02/13/08 11:58:34	115.0	65.6	9.0
02/13/08 11:58:44	104.3	65.6	8.8
02/13/08 11:58:54	97.0	65.6	8.6
02/13/08 11:59:04	93.0	66.1	8.4
02/13/08 11:59:14	101.7	67.0	8.0
02/13/08 11:59:24	120.3	67.9	7.8
02/13/08 11:59:34	135.5	68.8	8.2
02/13/08 11:59:44	138.2	66.1	8.4
02/13/08 11:59:54	139.1	63.4	8.4
02/13/08 12:00:04	167.4	65.2	8.0
02/13/08 12:00:14	182.2	67.0	8.4
02/13/08 12:00:24	158.6	67.3	9.0
02/13/08 12:00:34	115.1	67.9	9.3
02/13/08 12:00:44	74.9	66.7	9.2
02/13/08 12:00:54	58.3	65.8	9.0
02/13/08 12:01:04	63.9	65.9	8.8
02/13/08 12:01:14	88.0	65.8	8.2
02/13/08 12:01:24	192.3	66.8	7.2
02/13/08 12:01:34	300.9	67.9	7.4
02/13/08 12:01:44	325.2	68.2	7.3
02/13/08 12:01:54	295.3	68.5	7.7
02/13/08 12:02:04	268.1	67.9	7.5
02/13/08 12:02:14	303.8	67.0	7.2
02/13/08 12:02:24	360.4	67.9	7.2
02/13/08 12:02:34	342.1	68.8	7.9

02/13/08 12:02:44	253.3	67.6	8.6
02/13/08 12:02:54	168.6	66.4	8.4
02/13/08 12:03:04	126.0	66.2	8.5
02/13/08 12:03:14	99.9	66.1	8.9
02/13/08 12:03:24	82.1	64.9	8.9
02/13/08 12:03:34	74.0	63.8	9.0
02/13/08 12:03:44	68.4	63.8	9.2
02/13/08 12:03:54	67.2	64.1	9.8
02/13/08 12:04:04	67.2	63.2	9.2
02/13/08 12:04:14	74.0	62.6	8.8
02/13/08 12:04:24	77.9	64.4	8.9
02/13/08 12:04:34	71.6	66.1	9.6
02/13/08 12:04:44	58.6	65.3	9.7
02/13/08 12:04:54	54.1	64.4	9.3
02/13/08 12:05:04	55.3	65.0	9.1
02/13/08 12:05:14	58.0	65.2	9.2
02/13/08 12:05:24	52.7	65.5	10.0
02/13/08 12:05:34	43.9	65.5	10.3
02/13/08 12:05:44	39.2	64.1	9.7
02/13/08 12:05:54	41.2	62.6	9.3
02/13/08 12:06:04	44.2	64.7	9.3
02/13/08 12:06:14	54.7	66.7	8.9
02/13/08 12:06:24	70.8	66.4	9.4
02/13/08 12:06:34	68.7	65.9	9.3
02/13/08 12:06:44	60.4	65.5	9.1
02/13/08 12:06:54	49.0	65.5	9.3
02/13/08 12:07:04	45.4	66.1	9.2
02/13/08 12:07:14	59.2	67.0	8.5
02/13/08 12:07:24	94.8	67.6	7.8
02/13/08 12:07:34	182.5	68.5	7.3
02/13/08 12:07:44	241.8	67.6	8.2
02/13/08 12:07:54	218.4	66.7	8.6
02/13/08 12:08:04	166.6	67.9	8.5
02/13/08 12:08:14	116.6	69.4	8.8
02/13/08 12:08:24	82.5	69.7	8.9
02/13/08 12:08:34	65.4	69.7	8.6
02/13/08 12:08:44	77.3	69.7	8.6
02/13/08 12:08:54	79.7	69.7	9.0
02/13/08 12:09:04	77.3	69.4	8.5
02/13/08 12:09:14	97.5	69.4	8.2
02/13/08 12:09:24	113.6	69.6	8.5
02/13/08 12:09:34	111.2	69.9	8.7
02/13/08 12:09:44	91.2	69.4	8.9
02/13/08 12:09:54	73.4	69.1	9.0
02/13/08 12:10:04	65.1	68.8	8.7
02/13/08 12:10:14	86.2	68.8	7.8
02/13/08 12:10:24	137.6	67.0	7.4
02/13/08 12:10:34	190.2	65.6	7.7
02/13/08 12:10:44	192.9	67.0	7.9
02/13/08 12:10:54	233.9	68.8	7.1
02/13/08 12:11:04	339.1	69.7	7.5
02/13/08 12:11:14	332.7	70.6	8.1
02/13/08 12:11:24	252.7	70.3	8.7
02/13/08 12:11:34	146.0	70.0	9.1
02/13/08 12:11:44	84.2	68.2	9.4
02/13/08 12:11:54	55.3	66.7	9.8
02/13/08 12:12:04	41.5	65.3	9.8
02/13/08 12:12:14	34.7	64.1	9.8

02/13/08 12:12:24	34.2	64.1	9.5
02/13/08 12:12:34	37.7	63.8	9.5
02/13/08 12:12:44	46.6	63.8	8.8
02/13/08 12:12:54	76.4	63.8	8.4
02/13/08 12:13:04	90.0	65.3	8.7
02/13/08 12:13:14	84.4	66.7	8.6
02/13/08 12:13:24	93.6	66.8	7.7
02/13/08 12:13:34	130.1	66.5	8.1
02/13/08 12:13:44	132.6	67.3	8.9
02/13/08 12:13:54	107.0	68.3	8.9
02/13/08 12:14:04	71.4	67.9	9.1
02/13/08 12:14:14	54.7	67.9	9.1
02/13/08 12:14:24	51.7	67.4	9.4
02/13/08 12:14:34	49.2	66.7	9.2
02/13/08 12:14:44	46.0	67.0	9.7
02/13/08 12:14:54	48.9	67.1	10.4
02/13/08 12:15:04	59.5	61.1	10.6
02/13/08 12:15:14	70.2	54.8	10.2
02/13/08 12:15:24	68.1	47.1	10.8
02/13/08 12:15:54	14.9	36.4	12.9
02/13/08 12:16:04	6.6	34.0	13.4
02/13/08 12:16:14	2.8	31.6	14.1
02/13/08 12:16:24	0.7	30.0	14.7
02/13/08 12:16:34	0.5	28.6	15.1
02/13/08 12:16:44	1.5	27.4	15.4
02/13/08 12:16:54	6.0	26.2	15.5
02/13/08 12:17:04	17.9	25.9	15.7
02/13/08 12:17:14	43.3	25.3	15.9
02/13/08 12:17:24	76.7	25.3	16.1
02/13/08 12:17:34	112.1	25.3	16.4
02/13/08 12:17:44	145.9	24.7	16.6
02/13/08 12:17:54	175.1	23.8	14.9
Run 4 Average >	210.0	61.1	9.1

**APPENDIX E:**  
**FUEL ANALYSIS**

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**Hazen Research, Inc.**

4601 Indiana Street  
Golden, CO 80403 USA  
Tel: (303) 279-4501  
Fax: (303) 278-1528

Date March 13 2008  
HRI Project 002-WNO  
HRI Series No. B250/08-2  
Date Rec'd. 02/27/08  
Cust. P.O.#

Bison Engineering, Inc.  
Jim Wollenberg  
1400 11th Avenue  
Helena, MT 59601

Sample Identification  
Victor

Reporting Basis >	As Rec'd	Dry	Air Dry
Proximate (%)			
Moisture	46.28	0.00	5.99
Ash	0.33	0.61	0.57
Volatile	46.10	85.82	80.68
Fixed C	7.29	13.57	12.76
Total	100.00	100.00	100.00
Sulfur	0.05	0.09	0.08
Btu/lb (HHV)	4675	8703	8182
MMF Btu/lb	4691	8761	
MAF Btu/lb		8757	
Air Dry Loss (%)		42.86	

Ultimate (%)			
Moisture	46.28	0.00	5.99
Carbon	28.20	52.49	49.35
Hydrogen	3.01	5.59	5.26
Nitrogen	0.03	0.05	0.05
Sulfur	0.05	0.09	0.08
Ash	0.33	0.61	0.57
Oxygen*	22.10	41.17	38.70
Total	100.00	100.00	100.00

Chlorine\*\*

Forms of Sulfur (as S,%)

Sulfate		
Pyritic		
Organic		
Total	0.05	0.09

Water Soluble Alkalies (%)

Na2O  
K2O

Lb. Alkali/MM Btu=  
Lb. Ash/MM Btu= 0.70  
Lb. SO2/MM Btu= 0.20  
HGI= @ % Moisture  
As Rec'd. Sp.Gr.=  
Free Swelling Index=  
F-Factor(dry), DSCF/MM BTU= 9,399

Report Prepared By:

Gerald H. Cunningham  
Fuels Laboratory Supervisor

\* Oxygen by Difference.

\*\* Not usually reported as part of the ultimate analysis.

**APPENDIX F:**  
**NOMENCLATURE AND FORMULAE**

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## Nomenclature

$A_n$	sampling nozzle cross-sectional area , ft <sup>2</sup>	$C_{X(\text{corr})}$	actual gas concentration corrected to required percent O <sub>2</sub>
$A_s$	stack cross-sectional area, ft <sup>2</sup> <i>Note: Method 2 refers to this as A</i>	$D_{50}$	diameter of particles having a 50 percent probability of penetration, μm
$a$	mean particle projected area	$D_e$	equivalent diameter
Btu	unit heat value (British thermal unit)	$D_h$	hydraulic diameter
$B_{wm}$	percent moisture in gas at meter	$DH_{@}$	pressure drop across orifice meter for 0.75 CFM at standard conditions
$B_{ws}$	percent moisture in stack gas	DH	pressure drop across orifice meter
$C_1$	viscosity constant, 51.12 micropoise for K (51.05 micropoise for °R)	$D_n$	source sampling nozzle diameter
$C_2$	viscosity constant, 0.372 micropoise/K (0.207 micropoise/°R)	$D_{p50}$	50% effective cutoff diameter of particle, μ
$C_3$	viscosity constant, $1.05 \times 10^{-4}$ micropoise/K <sup>2</sup> ( $3.24 \times 10^{-5}$ micropoise/°R <sup>2</sup> )	$D_s$	diameter of the stack, feet
$C_4$	viscosity constant, 53.147 micropoise/ fraction O <sub>2</sub>	E	emission rate or mass/unit heat (Btu input)
$C_5$	viscosity constant, 74.143 micropoise/ fraction H <sub>2</sub> O	$e$	base of natural logarithms (ln10 = 2.302585)
$C_a$	concentration of acetone blank residue, mg/g	%EA	percent excess air
$C_{\text{cond}}$	concentration of condensibles, grain/dscf	$E_{\text{hr}}$	emission rate per hour, lb/hr
$C_{\text{cors}}$	concentration of coarse particulate, gr/dscf	$ER_{\text{cond}}$	emission rate of condensibles, lb/hr
$C_p$	pitot tube calibration coefficient, 0.84 for type S pitot tube	$ER_{\text{cors}}$	emission rate of coarse particulate, lb/hr
$C_p(\text{std})$	standard pitot-static tube calibration coefficient	$ER_{\text{mmBtu}}$	emission rate per mmBtu or ton of fuel, etc.
$C_{\text{PM10}}$	concentration of PM <sub>10</sub> particulate, gr/dscf	$ER_{\text{PM10}}$	emission rate of PM <sub>10</sub> particulate, lb/hr
$C_s$	particulate concentration in stack gas, mass/volume	$ER_x$	emission rate of compound which replaces x
cs12	particulate concentration corrected to 12 percent CO <sub>2</sub>	$F_c$	F factor for CO <sub>2</sub> , used with percent CO <sub>2</sub> , wet or dry basis
$c_{s50}$	particulate concentration corrected to 50 percent excess air	$F_d$	F factor for dry effluent, used with percent O <sub>2</sub> , dry basis
cws	particulate concentration on a wet basis, mass/wet volume	$f_o$	stack gas fraction O <sub>2</sub> , by volume, dry basis
		$F_o$	fuel factor
		$F_w$	F factor for wet effluent, used with percent O <sub>2</sub> , wet basis
		$\Delta H$	average pressure differential across orifice meter at control box
		$\Delta H_{@}$	orifice pressure, inches H <sub>2</sub> O

$\Delta H_d$	orifice pressure head, inches H <sub>2</sub> O, needed for cyclone flow rate	n	number of particles
%I	percent sampling rate variation, where 100% = ideal isokinetic conditions	$N_{re}$	Reynolds Number
j	equal area centroid	$\theta$	total sampling time, min.
$K_1$	0.001333 m <sup>3</sup> /ml for metric units 01.1 ft <sup>3</sup> /ml for English units <i>Equation 4-1</i>	$O_1$	plume opacity at exit
$K_2$	0.001335 m <sup>3</sup> /g for metric units 1. ft <sup>3</sup> /g for English units <i>Equation 4-2</i>	$O_2$	in-stack plume opacity
$K_3$	0.3858 °K/mm Hg for metric units 1. °R/in. Hg for English units <i>Equation 4-3</i>	$\Delta P$	stack differential pressure recorded by the probe's type S pitot tube
$K_p$	pitot tube equation dimensional constant, 85.49	$\Delta p$	velocity head of stack gas, mm H <sub>2</sub> O (in. H <sub>2</sub> O) - <i>Equation 2-8</i>
L	length of duct cross-section at sampling site	$\sqrt{\Delta P}$	average of the square roots of $\Delta P$ (may also be referred to as AS $\Delta P$ )
$L_1$	plume exit diameter	$\sqrt{\Delta P_1}$	square root of $\Delta P$ at point 1 of the current test
$L_2$	stack diameter	$\sqrt{\Delta P_1'}$	square root of $\Delta P$ at point 1 of the previous traverse
m	mass	$\sqrt{\Delta P'}$	average of the square roots of $\Delta P$ from the previous traverse (may also be referred to as AS $\Delta P'$ )
$M_a$	acetone residue weight after evaporation, mg	%CO <sub>2</sub>	percent CO <sub>2</sub> by volume, dry basis
mBtu	thousand Btu	%O <sub>2</sub>	percent O <sub>2</sub> by volume, dry basis
$M_{cond}$	mass of condensibles	%CO	percent CO by volume, dry basis
$M_{cors}$	mass of coarse particulate	%N <sub>2</sub>	percent N <sub>2</sub> by volume, dry basis
$M_d$	dry stack gas molecular weight	$P_{atm}$	atmospheric pressure
$m_f$	filter weight gain, mg	$P_b$	barometric pressure ( $P_b = P_{atm}$ )
$M_{fine}$	mass of PM <sub>10</sub> particulate	$P_{bar}$	barometric pressure at measurement site, mm Hg (in. Hg)
mmBtu	million Btu	$P_g$	stack static pressure, mm Hg (in. Hg)
$m_n$	total weight of collected particulate, mg	$P_i$	pitch angle at traverse point i, degree
$m_{n, pm10}$	total weight of collected PM <sub>10</sub> particulate, mg	$P_m$	absolute pressure at the meter
$M_s$	wet stack gas molecular weight	pmr	pollutant mass rate
$M_w$	molecular weight of water, 18.0 g/g-mole (18.0 lb/lb-mole)	$P_p$	absolute barometric pressure at the sample location, inches Hg
$M_{wx}$	molecular weight of gas species, g/gmol	$P_s$	absolute pressure in the stack

$P_{std}$	standard absolute pressure, 760 mm Hg (29.92 in. Hg)	$V_i$	initial volume, if any, of condenser water, ml
pts	number of traverse points during the test, minimum of 6, maximum of 12	$V_m$	dry gas volume measured by dry gas meter, dcm (dcf)
$\rho_w$	density of water, 0.9982 g/ml (0.002201 lb/ml)	$\Delta V_m$	incremental dry gas volume measured by dry gas meter at each traverse point, dcm (dcf)
q	time in minutes	$V_{max}$	maximum allowed nozzle velocity, fps
$Q_n$	stack gas volumetric flow rate, acfm	$V_{min}$	minimum allowed nozzle velocity, fps
$Q_s$	average stack gas wet volumetric flow rate, cfm (ft <sup>3</sup> /min)	$V_{m(std)}$	dry gas volume measured by the dry gas meter, corrected to standard conditions, dscm (dscf)
$Q_{sc}$	actual gas flow rate through the cyclone, acfm	$V_n$	target nozzle velocity, fps
$Q_{sc}'$	predicted actual gas flow rate through the cyclone, acfm	$v_s$	average stack gas velocity, m/sec (ft/sec)
$Q_{s(std)}$	total cyclone flow rate at standard conditions, dscm/min (dscf/min)	$V_w$	volume of water vapor
$Q_{std}$	dry volumetric stack gas flow rate corrected to standard conditions	$V_{w(std)}$	volume of water vapor in the gas sample, corrected to standard conditions, scf (standard cubic feet)
$Q_w$	wet stack gas standard volumetric flow, ft <sup>3</sup> /min, wscfm	$V_{wc(std)}$	volume of water vapor condensed corrected to standard conditions, scm (scf)
r	path length	$V_{wsg(std)}$	volume of water vapor collected in silica gel corrected to standard conditions, scm (scf)
R	ideal gas constant, 0.06236 (mm Hg) (m <sup>3</sup> )/(g-mole) (K) for metric units and 21.85 (in. Hg) (ft <sup>3</sup> )/(lb-mole) (°R) for English units	Volume	metric units = 0.00134 m <sup>3</sup> /ml x ml
$R_i$	resultant angle at traverse point i, degree	H <sub>2</sub> O	H <sub>2</sub> O English units = 0.04707 ft <sup>3</sup> /mlxmlH <sub>2</sub> O
$R_{max}$	multiplier for $V_n$	W	width of the duct cross-section at the sampling site
$R_{min}$	multiplier for $V_n$	$W_f$	final weight of silica gel or silica gel plus impinger, g
$T_m$	absolute temperature at meter, K (°R)	$W_i$	initial weight of silica gel or silica gel plus impinger, g
$t_s$	stack temperature, °C (°F)	$W_{ic}$	weight of collected water, g
$T_s$	absolute stack temperature, K (°R)	$X_d$	fraction of dry gas
$T_{s(avg)}$	average stack gas temperature, absolute, °R	Y	dry gas meter calibration factor
$T_{std}$	standard absolute temperature, 293 K (528°R)	$Y_i$	yaw angle at traverse point i, degree 0.280 molecular weight of N <sub>2</sub> or CO divided by 100
$T_t$	duration of test		
$\mu_s$	stack gas absolute viscosity, $\mu$ poise		
$V_f$	final volume of condenser water, ml		1. molecular weight of O <sub>2</sub> divided by 100

0.440 molecular weight of CO<sub>2</sub> divided by 100

18.0 molecular weight of water, g/g-mole  
(lb/lb-mole)

3,600 conversion factor, sec/hr

Subscripts:

atm atmospheric

ave average

b barometric

d dry gas basis

f final

g gauge

i initial

m at meter

n at nozzle

p of pitot tube

s at stack

SCF standard cubic feet

std standard conditions

w wet basis

## FORMULAE

1. Dry Gas Volume - Corrected to STP (40 CFR 60, App. A, Eq. 5-1)

$$V_{m(std)} = V_m Y \left( \frac{T_{std}}{T_m} \right) \left[ \frac{P_{bar} + \frac{\overline{\Delta H}}{13.6}}{P_{std}} \right]$$

Y is obtained from post-test meter calibrations.

2. Water Vapor Volume - Corrected to STP (40 CFR 60, App. A, Eq. 5-2)

$$V_{w(std)} = V_{lc} \left( \frac{\rho_w}{M_w} \right) \left( \frac{RT_{std}}{P_{std}} \right)$$

Note:  $W_{lc} = V_{lc} \rho_w$

3. Stack Gas Moisture Content (40 CFR 60 App. A, Eq. 5-3, modified)

$$B_{ws} = \frac{V_{w(std)}}{V_{m(std)} + V_{w(std)}}$$

4. Stack Gas Dry and Wet Molecular Weight (40 CFR 60 App. A, Eq. 3-1, 2-5)

$$M_d = 0.440(\%CO_2) + 0.320(\%O_2) + 0.280(\%N_2 + \%CO)$$

$$M_s = M_d(1 - B_{ws}) + 18.0B_{ws}$$

5. Average Stack Gas Velocity (40 CFR 60 App. A, Eq. 2-9)

$$v_s = K_p C_p \left( \frac{\sum_1^n \sqrt{\Delta p}}{n} \right) \sqrt{\frac{T_{s(avg)}}{P_s M_s}}$$

6. Average Stack Gas Wet Volumetric Flow Rate

$$Q_s = 60 v_s A_s$$

7. Average Stack Gas Dry Flow Rate Corrected to Standard Conditions (40 CFR 60 App. A, Eq. 2-10, modified)

$$Q_{std} = Q_s (1 - B_{ws}) \frac{T_{std}}{T_{s(avg)}} \frac{P_s}{P_{std}}$$

8. TSP Particulate Concentration Corrected to Standard Conditions (40 CFR 60 App. A, Eq. 5-6, modified)

$$c_{s,lb} = 2.205 \times 10^{-6} \frac{m_n}{V_{m(std)}}$$

$$c_{s,gr} = 15.43 \times 10^{-3} \frac{m_n}{V_{m(std)}}$$

Note:  $C_{s,lb}$  = lb/dscf  
 $C_{s,gr}$  = grains/dscf  
 $m_n$  = mg

9. TSP Emission Rate per Hour

$$E_{hr} = c_s Q_{std} 60$$

10. Percent Isokinetic Sampling Variation (40 CFR 60 App. A, Eq. 5-8)

$$I\% = \frac{T_{s(avg)} V_{m(std)} P_{std} 100}{T_{std} v_s \Theta A_n P_s 60 (1 - B_{ws})}$$

11. Percent moisture at 100 percent saturation (%SVP) equation:

$$\% SVP = \left[ \frac{100}{P_s} \right] \times 10^{\left[ 6.6911 - \frac{3144}{(T_{ws} - 390.86)} \right]}$$

where:  $P_s$  = stack pressure (absolute), inches of mercury  
 $T_{ws}$  = saturated stack temperature, degrees F

12. Emission Rate Compressor Engines (g/BHP-Hr)

$$E = \frac{(e) PPM Q_{STD}}{BHP}$$

13. Brake Horsepower for Compressor Engines

$$BHP = [43.6 \times MMCFD \times \left( \frac{T_{ts}}{T_{std2}} \right) \times \left( \frac{K}{(K-1)} \right) \times \left( R_2^{\frac{(k-1)}{k}} - 1 \right) \times LE \times FE] + Fan HP$$

14. Pounds Per Hour Emission Rate

$$lb/hr = E * BHP * \frac{lb}{453.59 g}$$

15. Analyzer Calibration error, in general, % diff.  $\leq$  2%

$$\% Diff. = \left( \frac{Cal. gas ppm - Analyzer response ppm}{Analyzer span ppm} \right) \times 100$$

16. System bias, in general <5% for both zero and upscale gases

$$\text{system Bias} = \left( \frac{\text{system cal. response ppm} - \text{Analyzer response ppm}}{\text{span gas ppm}} \right) \times 100$$

17. Calibration drift <3% for both zero and upscale gases during each run

$$\text{Cal. Drift} = \left( \frac{\text{final sys Cal. resp. ppm} - \text{initial sys cal. resp. ppm}}{\text{span gas ppm}} \right) \times 100$$

- 18.

$$\text{System Calibration Bias} = \left( \frac{\text{System Cal. Response ppm} - \text{Analyzer Cal. Response ppm}}{\text{span gas ppm}} \right) \times 100$$

- 19.

$$\text{Drift} = \left( \frac{\text{Final System Cal. Response ppm} - \text{Initial System Cal. Response ppm}}{\text{Span gas ppm}} \right) \times 100$$

20. Analyzer calibration error, in general, %diff. ≤ 2%

$$\% \text{ Diff.} = \left( \frac{\text{Cylinder ppm} - \text{analyzer response ppm}}{\text{span gas ppm}} \right) \times 100$$

21. Parts per million by volume (ppmv) to pounds per hour (lbs/hr)

$$\text{lbs/hr} = 1.558 \times 10^{-7} \times \text{molecular weight} \times \text{flow, dscfm} \times \text{ppmv}$$

$$\text{lbs/hr} = (\text{ppmv}) (1.558 \times 10^{-7}) (\text{MW}) (\text{dscfm})$$

ppm = parts per million

dscfm = dry standard cubic feet per minute

MW = molecular weight

22. Corrected concentrations to 12% CO<sub>2</sub>

$$Cs_{12} = Cs \frac{12}{\%CO_2}$$

23. Correcting concentrations to 6% O<sub>2</sub>

$$C_{s_{\%O_2d}} = C_s \left[ \frac{20.9 - 6\%O_2}{20.9 - \%O_{2d}} \right]$$

24. Concentration moisture corrections

$$C_d = (C_w) / (1 - B_{ws})$$

C<sub>d</sub> = concentration dry  
C<sub>w</sub> = concentration wet  
B<sub>ws</sub> = moisture content

25. Fuel Burning Rule

Fuel Input: Measure fuel introduced to the boiler bank. For example,

$$\begin{aligned} E &= 0.882 * H^{-0.1664} \\ E &= 0.882 (12,500 \text{ lb}_{\text{fuel}}/\text{hr} \times 4800 \text{ Btu}/\text{lb}_{\text{fuel}}) / (1 \times 10^6)^{-0.1664} \\ E &= 0.882 (60 \text{ MMBtu}/\text{hr})^{-0.1664} \\ E &= 0.4463 \text{ lb}/\text{MMBtu} \end{aligned}$$

Where E is the maximum allowable particulate emissions rate in lbs per MMBtu.

Steam Production: Measure steam produced by the boiler bank. For example,

$$\begin{aligned} E &= 0.882 * H^{-0.1664} \\ E &= 0.882 [(30,000 \text{ lb}_{\text{steam}}/\text{hr} \times 1,200 \text{ Btu}/\text{lb}_{\text{steam}}) / (60\%_{\text{boiler}} \\ \text{efficiency}) / (1 \times 10^6)]^{-0.1664} \\ E &= 0.882 (60 \text{ MMBtu}/\text{hr})^{-0.1664} \\ E &= 0.4463 \text{ lb}/\text{MMBtu} \end{aligned}$$

Where E is the maximum allowable particulate emissions rate in lbs per MMBtu.